BRITISH COLUMBIA DEPARTMENT OF MINES
Hon. W. J. ASSELSTINE, *Minister* JOHN F. WALKER, *Deputy Minister*

BULLETIN No. 9

Molybdenum Deposits of British Columbia

by

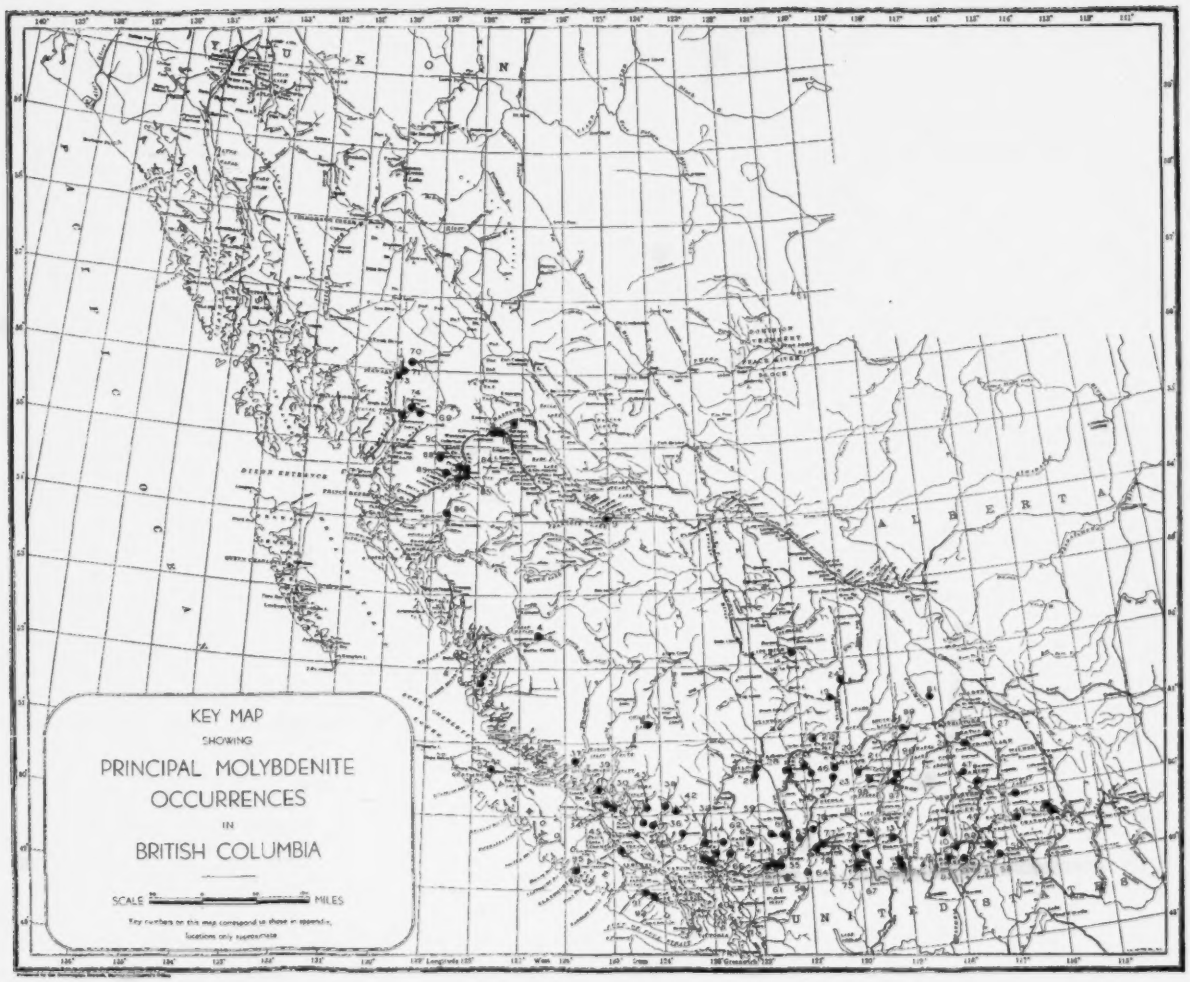
JOHN S. STEVENSON

•

1940

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA

VICTORIA, B.C.:
Photo-offset by CHARLES F. BANFIELD, Printer to the King's Most Excellent Majesty.
1940.



Key map showing principal molybdenite occurrences in British Columbia.

CONTENTS.

	Page
PREFACE	
INTRODUCTION	1
Molybdenum minerals	1
Geological occurrence	2
Metallurgy	3
Economics of molybdenum	4
Uses	4
Specifications of product, prices and tariffs	5
Grades of mineable ore	5
Production	6
DESCRIPTION OF PROPERTIES	
Ashcroft area - Martel	9
Fort Fraser area - Stella group	11
Grand Forks area - Midas group	16
- Molybdenum Nos. 1, 2, 3	19
Kamloops area - Anticlimax	20
- Kenallan	28
- Sands Creek	33
Lac la Hache area - Boss Mountain	34
Lower Mainland and Coastal Islands - Bentham molybdenite prospect	47
- Jervis Inlet	49
Nelson area - Gray Creek prospect	50
Little Keen	51
Molly mine	54
New Westminster area - Margaret group	58
Portland Canal area - Tidewater Molybdenum group	61
Revelstoke area - L. H. group	67
- Sterling group	70
Vancouver Island area - Allies group	73
BIBLIOGRAPHY	77
APPENDIX: Index of known occurrences of molybdenite in British Columbia	79

ILLUSTRATIONS.

Page

Key map showing principal molybdenite occurrences in British Columbia _____ Frontispiece

Figure (1) - Anticlimax molybdenite property: pace, compass and barometer survey _____ 23

Figure (2) - Consolidated Mining and Smelting Company molybdenite property, Boss Mountain. General plan of workings. Tape, compass survey _____ 37

Figure (3) - Consolidated Mining and Smelting Company molybdenite property, Boss Mountain. Detail of creek showings. Tape, compass survey _____ 39

Figure (4) - Tidewater molybdenum property. Plan showing surface geology _____ 61

Figure (5) - Tidewater molybdenum property. Plan showing underground geology _____ 63

Figure (6) - Tidewater molybdenum property. Assay plan _____ 67

Figure (7) - Allies molybdenite property: pace, compass and barometer survey _____ 76

Plate I, A - Mineralized boulder on Stella molybdenite property, showing typical ribbon-structure of vein, resulting from paper-thin layers of molybdenite in vein quartz. Boulder 3 feet long _____ 12

Plate I, B - Twin peaks of Boss mountain _____ 12

Plate II, A - Camp of Consolidated Mining and Smelting Company on their Boss mountain molybdenite property; camp at headwaters of Molybdenite Creek _____ 12

Plate II, B - Specimen showing brecciated nature of mineralized fracture-zone, Boss mountain molybdenite property of the Consolidated Mining and Smelting Company _____ 12

PREFACE.

The present bulletin includes geological descriptions of molybdenum deposits visited by the writer during the course of field work from 1937 to 1939, inclusive. With the exception of the deposit at Alice Arm, all the more important deposits and many, though not all, of the less important deposits in the Province were visited by the writer. J. T. Mandy of the Department of Mines examined the Alice Arm deposit in 1939, and a synopsis of his report is included in this bulletin.

To make the bulletin more comprehensive, an introductory chapter is included that briefly describes the mineralogy, geological occurrence, metallurgy and economics of molybdenum.

An appendix has been added to the bulletin in which brief notes are given concerning all the known occurrences of molybdenite in British Columbia that have come to the attention of the Mines Department. This appendix includes (1) occurrences fully described in this bulletin, marked with an asterisk, and (2) occurrences described elsewhere as indicated by the key of references and concerning many of which only incomplete information is available.

The writer wishes to acknowledge the kind assistance and cooperation rendered by mine officials and prospectors associated with the properties visited. Alan R. Smith, the writer's student assistant during the field seasons of 1938 and 1939, greatly facilitated the field work by his capable and hearty cooperation.

INTRODUCTION.

Molybdenum Minerals

There are many molybdenum minerals, but only one, molybdenite (MoS_2) is of commercial importance. The properties of molybdenite and of the more common molybdenum minerals are listed below.

Molybdenite - Composition - Molybdenum sulphide, MoS_2 = molybdenum, 60.0 per cent, sulphur, 40.0 per cent.

Lustre metallic. Colour lead gray, bluish gray streak as compared with the carbon-black streak of graphite. Opaque. Hardness, 1 to 1.5, Sectile. Laminae flexible but not elastic. Commonly foliated, in rosettes of crystals of fine granular.

Molybdite - Composition - molybdenum trioxide, MoO_3. Colour straw-yellow. Molybdite is often confused with molybdic ocher. Common oxidation product of molybdenite.

Molybdic ocher - Composition - hydrous ferric molybdate. Colour yellow. Often mistakenly called molybdite. Common oxidation product of molybdenite.

Wulfenite - Composition - lead molybdate, $PbMoO_4$ = molybdenum trioxide 39.3 per cent, lead oxide, 60.7 per cent. Lustre resinous - colour varies, grey, brown, orange-yellow, olive-green, orange to bright red. Streak white. Subtransparent. Hardness 2-3. Fracture subconchoidal. Occurs as tabular crystals or granular and massive.

Powellite - Calcium molybdate, chillagite, lead molybdate with lead tungstate, and koechlinite, bismuth molybdate, are rare.

Geological Occurrence

The following notes concerning the geological occurrence of molybdenite are given to assist in evaluating types of molybdenite deposits that may be found during the course of prospecting for this mineral.

Most molybdenite deposits are genetically related to rather acid igneous rocks such as granite, granodiorite and quartz-diorite. Deposits associated with diorite and more basic types are rare. In most instances the deposit occurs within the body of the igneous rock itself, or close to it.

Molybdenite deposits include the following types, listed in order of importance: (1) silicified fracture-zones; (2) quartz veins; (3) pegmatites and aplites; (4) high-temperature replacement deposits; (5) certain disseminated chalcopyrite deposits.

Silicified fracture-zones are characterized by brecciated rock, the fragments of which have been sealed by vein-quartz and molybdenite. The molybdenite may occur as coarse plates along the fractures, or as very fine grains within the quartz veinlets. The form of ore-body is commonly that of a pipe or stock with the vertical dimension greater than the horizontal. This type of deposit usually possesses a greater continuity of mineralization and resultant larger tonnage of ore than the other types of molybdenite deposits.

Molybdenite-bearing quartz veins are widespread, but the amount of molybdenite obtained from such deposits is not large. The veins range in width from a fraction of an inch to several feet, and from short lenses a few feet long to veins several hundred feet in length. However, not only are the veins often lenticular and discontinuous in length, but the molybdenite mineralization tends to be spotty in its distribution within the vein. For these reasons it is always wise to do a considerable amount of development on such a deposit before making commitments concerning possible tonnages.

The mineralogy of quartz-molybdenite veins is simple, consisting usually of quartz, molybdenite and pyrite, and occasionally chalcopyrite, sphalerite and galena.

Molybdenite-bearing pegmatite and aplite dykes are common, particularly in eastern Canada. The form of a pegmatite dyke is apt to be decidedly lenticular, aplites not so much so. The amount of molybdenite obtained from pegmatites and aplites

is not large, and, with a few exceptions, most occurrences are of more scientific than economic importance.

Two types of high temperature replacement deposits occasionally contain a little molybdenite. One type comprises bodies of lime-silicate and associated copper, iron and molybdenum sulphides that have formed by replacement of limestone. Because of the common lenticular nature of limestone replacement bodies and of the complex metallurgy necessary to extract the molybdenite from the intimately intergrown sulphides, that characterise this type of high temperature replacement deposit, these deposits are usually not of economic importance. The second type of high temperature replacement body is that where schists have been replaced by bodies that consist of quartz, feldspar, pyrrhotite and molybdenite; they are probably closely related genetically to replacement-pegmatites. These replacement bodies tend to be lenticular and sparsely mineralized by molybdenite. Most of these deposits are again of more scientific than economic importance.

A type of deposit which is not represented in British Columbia and only, so far as is known to the writer, found in the south-western United States and Mexico, is that which consists largely of chalcopyrite and/or chalcocite disseminated through large bodies of granitic rocks, which contain a small amount of molybdenite per ton. These deposits comprise large-scale copper mining operations and the molybdenite is recovered as a by-product molybdenite concentrate from copper ores. Because of the large tonnage of copper ore treated, the amount of by-product molybdenite is large. Such deposits include those at Bingham, Utah; Chino, New Mexico; Miami, Arizona and Cananea, Mexico.

Metallurgy

Molybdenite ores always require concentration. It is not economically practical to hand-short mine-run ore to a grade acceptable by ferro-metallurgical plants, the ultimate purchasers of molybdenite. Inasmuch as there are very few custom mills for molybdenite ores, and none in British Columbia, it is necessary that any owner or prospective purchaser of a molybdenite property bear in mind the probable necessity of doing his own concentrating.

Because of its flaky nature, molybdenite is not amenable to gravity concentration and flotation is used exclusively in its recovery. In a good mill a recovery of 80 to 90 per cent. is customary. A flotation concentrate ranging from 80 to 90 per cent. molybdenite (MoS_2) is usually made and shipped as

such to metallurgical plants.

The ordinary flotation mill-circuit is used. This employs the usual jaw-crushers, ball-mills, classifiers, rougher, scavenger and cleaner cells, thickeners, filters and drying pans. In a few deposits the molybdenite is in large crystals and it is not necessary to grind very finely, but in most deposits the molybdenite is very fine-grained and it is necessary to grind to minus 200 mesh. Because it is essential to keep the copper content of the concentrate down to Copper (Cu) 0.2 per cent., a good separation must be made between molybdenite and chalcopyrite. The dried molybdenite concentrate is packed in either heavy jute sacks or oak barrels for shipment to metallurgical plants for processing into molybdenum carbide, ferro-molybdenite, calcium molybdate, or into whatever form of molybdenum the smelters require for addition into the steel or steel-alloy furnaces.

Economics of Molybdenum

Uses:-- Most of the molybdenum produced is used in the iron and steel industry, and lesser amounts in the chemical and electrical industries.

The concentrate received from the mines is a concentrate of molybdenite (MoS_2), but for industry this is converted into one of the following forms: (a) ferro-molybdenum containing 60 to 65 per cent. molybdenum, or (b) calcium tungstate containing 35 to 45 per cent. molybdenum, or (c) less frequently molybdenum oxide briquets, or (d) the pure metal.

In the iron and steel industry, molybdenum is added to the steel both in the open-hearth or electric furnace as either ferro-molybdenum or calcium molybdate, although in 1939 experiments in adding molybdenum sulphide are reported to have met with some success. Other alloying metals are usually used with the molybdenum compound. In processes recently developed in the making of high-speed tool steels, molybdenum is being substituted for tungsten as the alloying metal of importance.

Molybdenum steels are reported to possess the following desirable qualities: greater hardness and strength at high temperatures, freedom from scaling and ease of forging, and resistance to creep and elongation at high temperatures.

In addition to molybdenum steels, there are many special alloys of molybdenum with cobalt, chromium and nickel that consume a fair amount of molybdenum. The most recent development in the use of molybdenum-alloys consists in plating molybdenum-

nickel over cadmium to give a molybdenum-black electroplating finish.

Molybdenum finds several uses in the chemical industry. It is used as a reagent in making certain analytical determinations, as sodium molybdate in the ink and dye industry, and as lead molybdate in the production of glass enamels.

In the electrical industry, molybdenum is used as the pure metal in the form of thin wires, ribbons or plates for incandescent lamps, radio tubes, heating elements in furnaces, in X-ray tubes and as electrical contact points.

A growing use for the metal is being developed in the sintered powdered metal industry.

Specifications of product, prices and tariffs:-- Inasmuch as most concentrates are purchased on a contract basis, requirements concerning the grade of the concentrate and the maximum amount of impurities permissible vary according to the uses to which the purchaser is going to put the concentrates.

The product is marketed as a concentrate ranging from 80 to 90 per cent. contained molybdenite (MoS_2). Copper is the most undesirable impurity, and most purchasers will not accept concentrates containing over 0.2 per cent. Copper (Cu). Iron should not exceed 10 per cent.; bismuth and tin not over 0.5 per cent. each.

The price for molybdenite is quoted nominally at New York as 45 cents per lb. of contained molybdenite (MoS_2), f.o.b. mines, on a 90 per cent. concentrate, and, likewise nominally, at London at 48 shillings per long ton unit of 22.4 lbs. for an 85 to 90 per cent. concentrate (E. and M.J. Metal and Mineral Markets - Feb. 29, 1940). An import tariff into the United States places a duty of 35 cents per pound of contained metallic molybdenum, or 21 cents per pound of molybdenite (MoS_2) in ore or concentrates.

The main desideratum of a purchaser of molybdenite is an adequate present supply of a uniformly high-grade product. Inasmuch as the material is used as an alloying metal in a steel bath, small deviations from the grade of the product and small increases in undesirable impurities will alter very considerably the physical characteristics of the resulting steel alloy.

Grades of mineable ore:-- As a guide to what constitutes mineable ore, the grades of ore at two important operating molybdenite mines are given. At Climax, Colorado, 12,000 tons of

ore daily are being mined from a large, uniformly mineralized body of sheared granitic rock; the ore averages 0.606 per cent. molybdenite, (MoS_2). At Questa, New Mexico, a much smaller tonnage of ore is being mined from several narrow quartz veins; the Questa ore ranges from 3 to 15 per cent. molybdenite (MoS_2) as mined, but by hand sorting and screening the mill feed is kept at or above 6 per cent. molybdenite (MoS_2).

These two examples, Climax and Questa, show that (1) in a deposit where the molybdenite is uniformly distributed through an area or zone of sheared rock, the tonnage of ore is much greater and much more certain and, therefore, the permissible grade of ore much lower than in the quartz-vein type of molybdenite deposit, and that (2) in a quartz-vein type of deposit the proven, as well as the probable ore, is much less and, therefore, the permissible grade of ore much higher than in type (1). In considering a property of type (1), the ore widths should not be less than a mining width, of say 3 feet, the indicated length should be 200 feet or more and the assay grade not less than 1 per cent. molybdenite (MoS_2). In considering a property of type (2), the quartz-vein type, ore widths should be at least 1 foot or if the veins are smaller, they should be close enough together to permit mining both the veins and intervening wall rock all together; the indicated length of the ore zone should be 200 feet or more and the assay across individual veins of a foot or more in width not less than say 10 per cent. molybdenite (MoS_2).

Production:--The greatest part of the world's production of molybdenite comes from the United States, and most of the remainder from Mexico and Norway.

The Climax, Colorado mine of the Climax Molybdenum Company produced 78 per cent. of the world output, and 85 per cent. of the United States output in 1938. The only other important molybdenite mine in the United States is that of the Molybdenite Corporation of America near Questa, New Mexico. However, a considerable tonnage of molybdenite is produced as a by-product from several of the large copper mines in the south-west; these include the Bingham Canyon, Utah, property of the Utah Copper Company; the Chino, New Mexico, property of the Nevada Consolidated Copper Corporation; and the Miami, Arizona, property of the Miami Copper Company. During 1939, by-product molybdenite accounted for one-fourth of the United States production.

The Mexican output of molybdenite is a by-product concen-

trate in the treatment of copper ores from the Cananea, Mexico, copper property of the Greene Cananea Copper Company; this mine produced 483 metric tons of molybdenum in 1938.

The Norwegian production comes from a molybdenite mine at Knaben; this mine produced 450 metric tons of molybdenum in 1938.

Chile, South America, entered into the world's production picture in 1939 when the Braden copper mine at Sewell, Chile, began the production of by-product molybdenite.

Although the world's leading producer of molybdenite during the last Great War was the Moss mine, at Quyon, Quebec, the production of molybdenite today from Canada is small. The Zenith Molybdenite Company, Renfrew County, Ontario, apparently the only operation in 1938, produced 7 metric tons of concentrates. However, development work and metallurgical testing of ore are being carried on at a number of properties in Quebec, Ontario and British Columbia.

World

Molybdenum Ores and C

(Comp

Country
Australia:
New South Wales (concentrates)
Queensland (concentrates)
Victoria (concentrates)
Burma
Canada (concentrates)
China (ore containing 45% Mo)
Chosen (ore)
Italy (ore)
Japan (dressed ore)
Mexico (Mo content)
Morocco, French (concentrates) (3)
Norway (Mo content)
Peru (concentrates)
Rumania (Bi-Mo ore)
Turkey (ore)
United States (Mo content)
Yugoslavia

(1) Less than 1 ton.
(2) Data not available.
(3) Exports.

d Production of

oncentrates, 1934-38, in Metric Tons

iled by M.T. Latus, U.S. Bur. Mines, 1939, p. 619.)

1934	1935	1936	1937	1938
3	--	(1)	16	(2)
1	11	20	23	14
--	--	--	31	36
--	--	--	(1)	(2)
--	--	--	7	--
2	(2)	(2)	(2)	(2)
104	106	80	(2)	(2)
--	--	861	46	(2)
5	6	7	(2)	(2)
467	687	534	629	483
149	190	187	195	258
146	388	422	344	450
15	13	19	83	153
6	14	46	27	(2)
--	--	--	43	(2)
4247	5222	7795	13344	15103
--	18	--	84	19

It is to be noted that the greater part of the world's production of molybdenite comes from the Cordillera, the mountain ranges that comprise the western part of North America. Even excepting the Climax, Colorado deposit, which is responsible for 85 per cent. of the United States production, by far the greater part of the remainder comes from a section of the Cordillera that extends from Mexico to Utah. The northerly extension of the Cordillera from the United States into British Columbia is not essentially unlike that of the United States, and in view of the success that has attended the development of molybdenite prospects in the United States, prospecting for molybdenite and the development of molybdenite prospects in the British Columbia section of the Cordillera should be encouraged.

MARTEL (1)/ The Martel Gold Mines, Limited of 716 Hall Building, Vancouver, owns a gold-molybdenite property commonly known as the Martel. This property includes the mineral claims Hat Nos. 1 to 11 inclusive, staked in 1933, the Bug Nos. 12 to 14, inclusive, staked in 1933, the Axe, staked in 1932, the Boe and Boe No. 1, staked in 1933 and the Dave, Matt and Vernon staked in 1933. The writer, accompanied by J. M. Cummings of this Department, examined the showings in July, 1937.

The property is in Venables Valley, 13 miles north of Spence's Bridge and approximately 5 miles north-west of Martel, a station on the Canadian National Railway. A road to the claims leaves the Cariboo Highway at a point 13 miles north of Spence's Bridge and goes south-westerly for 2 1/2 miles to Venables Valley, thence along the valley south-easterly for approximately half a mile to the property on the south-west side of the valley. The camp is at the end of a short branch-road leading to the mine, and the workings are 180 feet above the camp.

The hillside in the vicinity of the workings is steep and covered by an open-growth of light timber; the underbrush is not heavy. The overburden is comparatively shallow and rock exposures and bluffs are common, particularly above the workings.

The deposit consists of a group of small, lenticular quartz veins in argillaceous sediments and intercalated vol-

---

/ This number appears on the key map (frontispiece) where it indicates the approximate position of the property.

canics. The veins range in thickness from a knife-edge to 12 inches, and from sections 2 feet long to 60 feet in length. The mineralization consists of quartz and small amounts of molybdenite. Where heaviest, the molybdenite occurs in paper-thin ribbons that parallel the walls of the vein. In all, twenty-six samples were taken from the veins, adjoining wall rock and faults underground; one sample contained: Molybdenite, 0.2 per cent.; all the other samples assayed traces and nils. Samples assayed for gold and silver also ran traces and nils, with the exception of one which assayed: Silver, 0.2 ounces per ton.

The main working is an adit, 1032 feet long, driven as follows: from the portal, south 10 degrees west for 376 feet, then south 60 degrees west for 24 feet, then north 70 degrees west for 134 feet to the face. At 164 feet from the portal a short working extends north 75 degrees east for 24 feet. At 178 feet from the portal, a working, known as the East Drift, extends south 55 degrees east for 112 feet, then south 20 degrees east for 22 feet, then south 30 degrees west for 16 feet, then south 50 degrees west for 48 feet to the face. From the same point, 178 feet from the portal, a short working extends north 55 degrees west for 24 feet to the collar of a winze, which is sunk on a 60-degree slope south 10 degrees west for 88 feet. This winze will be referred to as the 60-degree winze. At a point 48 feet from the collar of the winze, a working extends south 75 degrees east for 48 feet to the face. At 20 feet from the winze a short drift extends south 10 degrees west for 12 feet along a 10-inch wide quartz vein. At 188 feet from the portal of the adit, a working extends south 75 degrees west for 20 feet. From the end of this working a winze is sunk south 75 degrees west for 55 feet on a 30-degree slope. This winze will be referred to as the 30-degree winze. Ten feet up from the bottom of the winze a working extends north 20 degrees west for 32 feet.

Between points 164 and 178 feet from the portal, the adit follows two 6-inch quartz veins that strike north 40 degrees east and dip 70 degrees north-westward. To the north-east they die out in the wall, and to the south-west, continuation of the veins is displaced 15 feet south-easterly by a strong fault. The "East Drift" follows this fault, strike north 48 degrees west, dip 60 degrees south-westward, for 105 feet south-easterly and for 24 feet north-westerly; the 60-degree winze follows down the dip of the fault at this point. Between 178 feet and 188 feet from the portal the main adit follows the veins, and then, at 188 feet, the branch working and 30-degree winze follow the veins for a combined distance of 72 feet. Close to the entrance of the 30-degree winze the veins have

been cut by a vertical fault that strikes north 80 degrees west and displaces the veins 6 inches. Down this winze, the veins that range from 1/2 an inch to 6 inches wide, are decidedly lenticular and discontinuous and tend to feather out into stringers.

At a point 48 feet from the collar of the winze, a drift is driven along the vertical fault, and at a point 4 feet from the side of the winze, on the north-east or footwall-side of the fault, this drift intersects the downward continuation of one of the veins from the level above and, 10 feet farther along, the faulted continuation of this vein and other lenses in the hanging-wall. These veins range from 4 to 12 inches in width.

Two, and in places three, stringers of unmineralized quartz ranging from 1/2 an inch to 2 inches in thickness, extend south-easterly for 108 feet back from the face of the main adit.

At a point 256 feet south-easterly around the hillside from the adit and approximately at the same elevation, an open-cut has been driven south 40 degrees west for 12 feet across sediments that strike north 40 degrees west and dip 50 degrees south-westward.

Fifty feet south-east from this cut a second one has been driven south 40 degrees west for 7 feet in sediments of a similar attitude.

Small areas of quartz-diorite that may constitute a dyke, outcrop south-west and north-east of the open cut.

No mineralization was seen in either of the above cuts.

STELLA (9) The Stella group consists of the Stella Nos. 1 to No. 4 mineral claims, staked in 1927 by Chas. H. Foote, and owned by Foote and associates, all of Fraser Lake. The writer examined the property in July, 1938.

The property is south of Endako, a small settlement on the Canadian National Railway and highway, approximately 120 miles west of Prince George. It may be reached from Endako by following a motor-road, that branches from the main Endako-Prince George highway at a point 3.5 miles easterly from Endako, for 3 miles southerly, and thence along a logging-truck road westerly for 2 miles to a group of deserted camp-buildings at an elevation of 2955 feet; thence a trail leads south-

westerly for 6700 feet to the camp-cabin at an elevation of 3380 feet.

The workings consist of one adit, an inclined shaft and several surface cuts, some of which never reached bed-rock. All the workings that reach bed-rock are either on the top of or on the southerly slope of a low, round-topped, open-timbered ridge, the crest of which begins a quarter of a mile south-easterly from the camp-cabin and extends for three-quarters of a mile in a direction south 75 degrees west. The ridge rises to a height of approximately 200 feet above the surrounding lowland. The workings that do not reach bed-rock are on the crest and southerly slopes of the north of the two knolls that constitute the westerly end of the ridge. This north knoll is separated from the one to the south by a swamp approximately 250 feet wide; the crest of the knoll is 75 feet above the swamp.

The showings consist of scattered discontinuous quartz-molybdenite veins in pink granite.

The veins range in strike from north 70 degrees east to south 80 degrees east, and in dip, from vertical to 60 degrees southward. They range in width from 2 to 32 inches and in length from a few feet to 8 feet, with the exception of the best showing in the shaft which has an indicated length of 75 feet. Most commonly, the veins possess a ribbon texture, caused by closely spaced films of very fine-grained molybdenite that parallel the walls of the vein (Plate I A).

The mineralogy of the veins is simple, consisting of fine-grained molybdenite and occasionally a little pyrite in vein quartz.

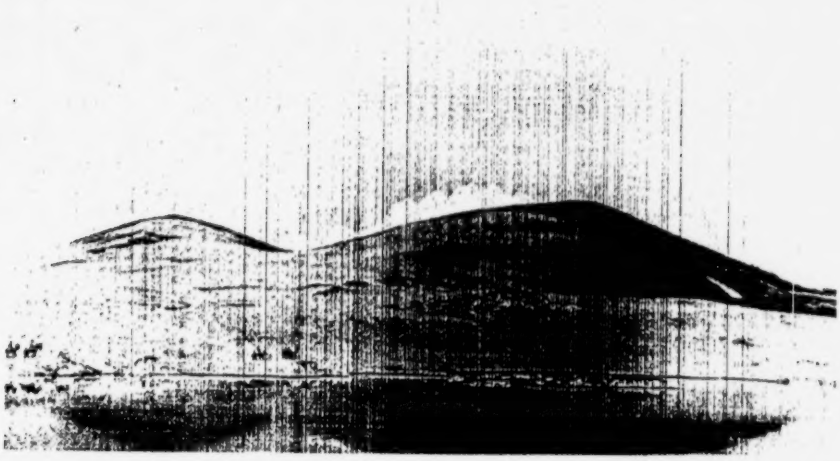
The prevailing rock is a medium-grained pink granite, that in a few places is cut by lenses of aplite.

The main showings lie on the top and southerly slope of a ridge that extends south-westerly from the camp-cabin for approximately three-quarters of a mile.

At an elevation of 3430 feet an adit has been driven north-westerly into the hillside for 35 feet from a point 3600 feet in a direction south 55 degrees west from the camp-cabin; the adit is timbered nearly to the face and could not be examined. The rock consists of pink granite that at the face is cut by numerous closely-spaced fractures, strike east and dip 65 degrees south. At a place 5 feet back from the face, the rock in the adit-floor is irregularly fractured

PLATE I.

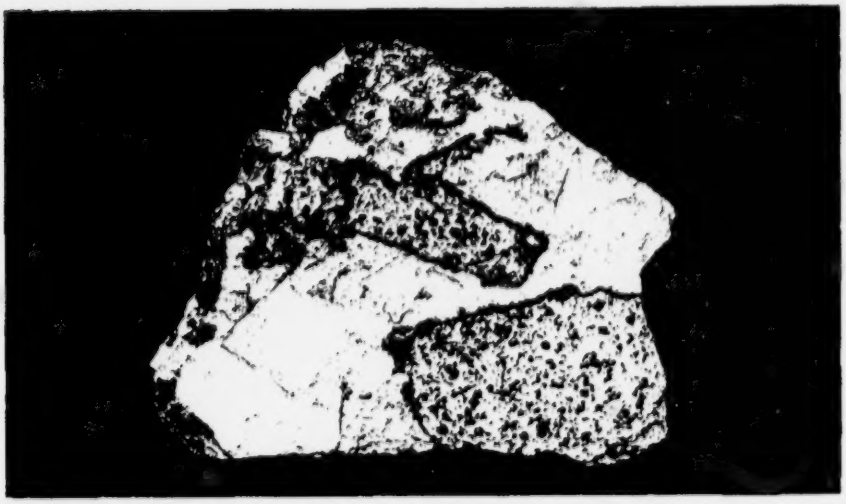
A. Mineralized boulder on Stella molybdenite property, showing typical ribbon-structure of vein, resulting from paper-thin layers of molybdenite in vein quartz. Boulder 3 feet long.



B. Twin peaks of Boss mountain.

PLATE II.

A. Camp of Consolidated Mining and Smelting Company on their Boss mountain molybdenite property; camp at headwaters of Molybdenite Creek.



B. Specimen showing brecciated nature of mineralized fracture-zone, Boss mountain molybdenite property of the Consolidated Mining and Smelting Company.

and contains a small amount of molybdenite.

No. 1 showing is a cut at an elevation of 3480 feet and 115 feet in a direction north 64 degrees west from the portal of the adit. This cut has been driven for 15 feet in a direction north 8 degrees east to a 10-foot face which has largely sloughed. A sample of average material taken from an ore pile 5 feet in diameter by 1 foot in depth, assayed: Molybdenite, 0.8 per cent. This broken vein-matter consists of thin films or ribbons of molybdenite in quartz.

No. 2 showing is an irregular stripping at an elevation of 3480 feet and 30 feet in a direction north 65 degrees west from No. 1 showing. At the east end of the stripping, three 2-inch quartz-molybdenite veinlets strike east and dip 60 degrees south. The dump, however, shows pieces of ore that indicate occasional vein-widths of 6 inches.

No. 3 showing, a trench at an elevation of 3460 feet and 210 feet in a direction south 85 degrees west from No. 2 showing, is 20 feet long in a northerly direction that exposes only granite in the floor.

No. 4 showing, an irregular stripping that extends 17 feet in an easterly direction and 10 feet to the north is at an elevation of 3460 feet and 30 feet westerly from No. 3 showing. The stripping exposes an irregular area of granite approximately 6 feet in diameter, that has been cut by numerous quartz stringers and is marked on the north side by a strong 16-inch vertical band of quartz striking north 70 degrees east for 8 feet. The westerly extension of this band is obscured by overburden and to the east it is terminated by a vertical 3-inch shear-zone striking north. A small amount of molybdenite occurs in the quartz of the showing. A sample taken across a 16-inch width of this quartz assayed: Molybdenite, 0.85 per cent. A 6-foot sample taken along the east edge of the area assayed: Molybdenite, 0.6 per cent. From the south edge of the stripping, a trench extends southerly in overburden, and from the north side a trench extends 14 feet northerly in granite.

At an elevation of 3400 feet, No. 5 showing, an inclined shaft, has been sunk in a direction south 15 degrees east for 24 feet, on a slope angle of 53 degrees from a point 320 feet in a direction north 32 degrees west from the portal of No. 1 adit. At the time of the writer's examination, (July, 24, 1938) the water level in the incline was 17 feet below the collar.

The incline has been sunk on a lenticular vein of quartz that, above the water level, ranges from 32 inches to 24 inches in width on the west wall of the incline and from 2 inches to 4 inches in width on the east wall. A sample taken across 32 inches at a point on the west wall 5 feet from the collar assayed: Molybdenite, 1.6 per cent. The vein is conspicuously fractured into slabs ranging from 3 to 6 inches in width by fractures that parallel the walls of the vein. In the hanging-wall the vein is followed by a 2-foot zone of granite that is badly broken by closely spaced, criss-crossing joints, and, as a result is quite fragmental and badly oxidized; narrow irregular stringers of quartz and molybdenite traverse this zone. A 2-foot sample taken across this zone assayed; Molybdenite, 0.7 per cent.

A trench extends southerly for 20 feet from the south edge of the incline. For 2 feet from the edge of the shaft this trench exposes a fracture-zone that consists of quartz and molybdenite surrounding numerous granite inclusions; this zone strikes and dips with the main quartz vein of the shaft. A sample of the material in this zone assayed: Molybdenite, 1.4 per cent. For the remaining 15 feet of its length, the trench exposes badly fractured, more or less decomposed, granite that contains occasional quartz lenses from 1 inch to 4 inches wide in which a small amount of molybdenite occurs. One 10- and one 8-foot long sample, taken along the wall of the trench, assayed: Molybdenite, 0.2 per cent. and 0.3 per cent. respectively.

For a distance of three-quarters of a mile north-easterly and to the east of the shaft, several trenches have been dug, but it is reported that none of these reached bed-rock.

No. 6 showing, a 20-foot trench, at an elevation of 3410 feet, is 30 feet in a direction south 65 degrees west from the shaft. At a place 5 feet from the south end of the trench a 10-inch width of vein-matter is exposed that is probably a continuation of the shaft vein; the full width of this vein was not exposed.

No. 7 showing, is a trench 6 feet long, at an elevation of 3420 feet, and 30 feet south-westerly from No. 5. The only exposure in this trench is a 2-foot width of quartz-molybdenite vein-matter that also appears to be a continuation of the shaft vein. A sample taken across the full 2 feet assayed: Molybdenite, 1.0 per cent.

No. 8 showing, is a sloughed trench that is 30 feet south-westerly from No. 6. No rock is exposed in the trench but it

is reported that the vein was found and a large piece of rock nearby, 3 feet by 2 feet by 18 inches, suggests that the vein was 18 inches wide.

Exposures in the trenches infer that the shaft-vein extends westerly for at least 75 feet from the shaft. Surface work has failed to find any easterly continuation.

Several trenches have been dug in the vicinity of quartz-molybdenite float which is scattered on a low hill 900 feet north-westerly from the shaft across a swampy depression.

The first of these trenches, described as No. 9, lies at an elevation of 3375 feet and is 870 feet in a direction north 88 degrees west from the shaft. This trench and others, one lying 75 feet westerly from it, and the remainder within a distance of 400 feet north-easterly up the hill and on its summit (elevation 4310 feet), failed to reach bed-rock, but the drift, and glacial till, that they cut, consists of occasional small boulders of quartz-molybdenite vein-matter.

At a point that is approximately 700 feet south-easterly from the camp-cabin, a cut has been driven for 12 feet in a direction north 30 degrees east into the southerly slope of a knoll on the north edge of a small muskeg-area. This cut is in coarse-grained, pink granite that contains a few irregular quartz veins which range in width from a knife edge to 6 inches; the borders of these veins are not sharp and the vein-matter contains small inclusions of the wall rock, but no molybdenite. Some irregular areas of pink aplite were seen in the surrounding granite.

Several open-cuts have been dug on exposures on the southerly slope of a hill that lies one-quarter of a mile southerly from the camp-cabin.

The first of these, described as showing No. 10, lies at an elevation of 3320 feet on the southerly slope of the hill at a point 1800 feet in a direction south 8 degrees east from the camp-cabin. This working, a pit 5 feet in diameter, and 2 feet deep, was caved at the time of examination (July 24, 1938), but the dump showed approximately 100 lbs. of quartz-molybdenite vein-matter, and the material indicates that the vein must have been at least 6 inches wide. The rock formation is pink granite.

No. 11 showing is a 10-foot trench at an elevation of 3370 feet and 350 feet in a direction north 70 degrees west from No. 10. The only exposure in this trench is part of a

flat-lying piece of vein-float at the north-westerly end of the trench. However, the dump shows 150 lbs. of vein-matter consisting of quartz, ribboned by thin molybdenite seams; vein widths of at least 6 inches are indicated by the dump-material.

No. 12 showing is a shallow pit 4 feet in diameter, at an elevation of 3330 feet and 1075 feet in a direction south 65 degrees west from No. 11. This pit exposes patches of a lenticular vein that ranges from 1/4 of an inch to 4 inches in width, on a plane surface of pink granite that strikes east and dips 30 degrees northward.

No. 13 is an irregular stripping 4 feet by 2 feet in dimensions, at an elevation of 3310 feet, and 350 feet in a direction south 67 degrees west from No. 12. It exposes part of a quartz-molybdenite lens that strikes north 25 degrees east, dips 50 degrees north-westward and is 24 inches thick. A sample across the full 24-inch width assayed: Molybdenite, 0.5 per cent.

Prospecting to date indicates the presence of a fair grade of molybdenite mineralization. The writer suggests that the shaft-vein be prospected further.

MIDAS (11) This molybdenite property includes the Midas Nos. 1 to 4 mineral claims staked in May, 1938, by F. O. Friske and owned by A. J. Cleeton of Cascade. This property was examined by the writer in June 1938.

The claims lie in the Trail Creek Mining Division to the north-east of the flag-station Tunnel on the Kettle Valley Branch of the Canadian Pacific Railway. Tunnel is at mileage 50, as measured westerly from Nelson. From Tunnel the property is reached by leaving the railway at Mile - 47.5 and proceeding up the relatively open hillside and along the ridge-top in a south-westerly direction for approximately 2 1/2 miles. There is no well-defined trail.

The showings are extremely old and the surface work is all caved. The main workings are two adits, at approximately 5000 feet elevation, on the easterly side of a northerly trending ridge and approximately 80 feet below the crest. This ridge is the top of a spur that extends down to the north between Brooklyn and Pup Creeks. There is also an open-cut and caved shaft on the easterly side of the ridge only a few feet below the top at a point approximately 1000 feet to the south of the adits.

The ridge-top in the vicinity of the workings is quite

open, the timber having been burnt by a large fire about 1932. The slopes on either side are steep and covered by either talus or a veneer consisting of talus and soil; the overburden is not deep.

There are no camp-buildings on the property.

The Midas molybdenite deposit consists of small amounts of molybdenite in quartz stringers and in slightly-brecciated syenite. Very little mineralized material was found in place by the writer. Small amounts of fluorite, chalcopyrite and more abundant pyrite, and magnetite and hematite occur with the molybdenite.

The most abundant rock on the property is syenite. It is a medium-grained rock, somewhat porphyritic in texture, of a definitely-pink colour and consists mostly of pink potash feldspar. The syenite is cut by feldspar-porphyry dykes that range from 4 to 8 feet in width, strike easterly and dip 70 degrees northward; only two such dykes were seen on the property. One narrow andesitic dyke was seen, in the upper adit. This dyke is 18 inches wide, dark-green in colour and relatively fresh in general appearance.

An adit has been driven to the west for 104 feet into the hillside from a point 85 feet below the crest at a point approximately 2 1/2 miles southerly from mileage 47.5 on the railway. The working has been driven north 87 degrees west as an open-cut for 20 feet, then as an adit for 32 feet, then north 66 degrees west for 40 feet, then south 81 degrees west for 25 feet and lastly north 50 degrees west for 7 feet to the face. At the portal a shaft has been sunk on a 70-degree slope north-westward, a minimum distance of 10 feet. The shaft was filled with water at the time of the writer's examination (June, 1938). From the open-cut, the adit follows the south wall of a westerly striking feldspar-porphyry dyke for 72 feet. This dyke ranges from 6 to 8 feet in width and dips 70 degrees northward. At 32 feet from the portal an 18-inch, andesite dyke strikes north-westerly across the adit, but on reaching the foot-wall of the porphyry dyke it bends and follows this to a point 40 feet farther in where the adit leaves both dykes.

A small dump of approximately half a ton, was seen at the portal, but very little mineralized material could be found in place. The only mineralization consisted of a few splashes of hematite and magnetite along the contact of the syenite and feldspar-porphyry dyke at the portal. The shaft has been sunk at this point and it is presumed that the molybdenite on the

dump was found in the shaft and in the vicinity of, if not actually along, the contact. The mineralized material on the dump consists of blebs of molybdenite ranging from 1/16 to 1/2 an inch in diameter, that occur in narrow quartz stringers or slightly brecciated syenite. Small amounts of fluorite and chalcopyrite, and in places much pyrite, and magnetite and hematite occur with the molybdenite; of these minerals, molybdenite is one of the least abundant. A sample representative of dump material assayed: Molybdenite 2.1 per cent.; Gold, nil; Silver, nil; Copper, 0.1 per cent.

A second adit has been driven from a point south 80 degrees east from and 40 feet below the first adit. This working has been driven in a direction south 80 degrees west as an open-cut for 12 feet, thence in the same direction as an adit for 30 feet, then north 70 degrees west for 16 feet to the face. A winze filled with water at the time of the writer's examination (June, 1938) has been sunk at 30 feet from the portal. From the mouth of the open-cut, a second open-cut has been driven north-westerly for 4 feet and westerly for 8 feet to an incline shaft sunk 10 feet on a 60-degree slope westward. Both the adit and entry open-cut follow the hanging-wall of a feldspar-porphyry dyke. This dyke strikes westerly and dips 70 degrees northward; it is not the same dyke as the one exposed in the upper adit.

The second open-cut follows the foot-wall of the dyke. Other than the feldspar-porphyry, the rock is pink syenite. No mineralized material could be found in place, but about 50 lbs. of molybdenite-bearing material was seen in a small dump. The mineral association is similar to that as described for the upper adit.

At a point approximately 1000 feet to the south along the ridge, an open-cut extends in a direction north 10 degrees west for 12 feet to what was apparently a shaft; now entirely caved. From the shaft a trench extends along the hillside in a direction south 70 degrees west for 25 feet; this trench is largely caved. Molybdenite and its yellow oxidation product, molybdite, occur in short stringers in pink syenite within a zone approximately 6 feet wide that strikes north-westerly across the caved shaft. The stringers average 1 foot in length by 1 inch in thickness and contain, in addition to molybdenite, abundant magnetite and hematite. A picked sample from a small pile of mineralized material at the mouth of the cut assayed: Molybdenite 0.3 per cent.; Gold, nil; Silver, nil; Copper, nil.

MOLYBDENUM, NOS. 1, 2, 3. (12)

This prospect comprises the Molybdenum Nos. 1, 2 and 3 mineral claims staked in 1937 by E. and J. C. Ness and owned by the estate of the late H. B. Thomson. The writer examined this occurrence in June, 1938.

The property lies westerly up the hillside across McRae Creek from Lafferty, a flag-station on the Kettle Valley branch of the Canadian Pacific Railway, 10.5 miles northerly from Cascade.

The showings are about two-thirds of a mile westerly by trail from a point on the Christina Lake-Paulson road that is 7 1/2 miles northerly from the junction of the Christina Lake road with the main Cascade-Rossland highway.

The occurrences consist of scattered flakes of molybdenite in quartz-feldspar-biotite gneiss. Some of the gneiss contains pegmatitic material consisting of quartz and feldspar occurring as a fine-grained graphic intergrowth. There does not appear to be any controlling structure for the molybdenite other than ordinary foliation of the gneiss. Samples taken by the writer assayed from: Molybdenite, 0.04 to 0.8 per cent.

The workings are on a steep, lightly wooded hillside; between elevations of approximately 1,000 feet and 1,400 feet above the road. They consist of two open-cuts, a blasted area, and an old shaft 10 feet deep.

The lowermost working is a blasted area, at the base of a low bluff, that exposes a fresh face of rock measuring 8 feet in an easterly direction along the bluff by 4 feet high. Scattered flakes of molybdenite occur in a coarse quartz-feldspar gneiss the foliation of which strikes north 40 degrees east and dips 30 degrees south-eastward. A sample taken across 3 feet of the best mineralization assayed: Molybdenite, 0.04 per cent.

The next working is an old shaft that is 125 feet in a direction north 57 degrees east from the last working. This shaft has been sunk for 10 feet in quartz-biotite schist that strikes north 20 degrees east and dips 30 degrees south-eastward. The schist contains scattered blebs and fine grains of pyrrhotite along the schistosity but no molybdenite.

Approximately 1000 feet northerly from the shaft a rectangular rock trench extends in a direction north 60 degrees

west for 18 feet across quartz-feldspar gneiss that strikes north 45 degrees east and dips 35 degrees south-eastward. Molybdenite is scattered in the gneiss, particularly in a zone approximately 18 inches wide towards the south-east end of the trench. A sample taken across this zone assayed: Molybdenite, 0.8 per cent, and a picked sample from a small dump nearby assayed: Molybdenite, 1.4 per cent.

A short distance to the north along a rounded rock nose the uppermost working has been driven as an open-cut in an easterly direction for 40 feet on the easterly side of the rock slope. The rock here is gneiss similar in kind and attitude to that in the last working. Several blebs of finely graphic-quartz in feldspar were seen in this gneiss. Molybdenite is scarce in the cut. A sample taken for 10 feet along the north wall of this cut, and another taken along a further 30 feet on the same side both assayed: Molybdenite, 0.04 per cent. Picked material from the ore-dump assayed: Molybdenite, 0.2 per cent.

ANTICLIMAX (19). The Anticlimax molybdenite property, north-west of Littlefort, comprises the mineral claims, Anticlimax Nos. 1 to 7 inclusive.

These claims were staked by Nowell Sadlier-Brown as agent, in May, 1939, and are owned by various people including C. A. Reid and the Loveway brothers of Littlefort (Mt. Olie) and by N. S. Brown, L. S. Brown and D. S. McTavish of Kamloops. The Blue Jay, Whiskey Jack and Buckhorn claims staked by Reid and the Lovewàys in April, 1938, have since lapsed. The property was examined by the writer in August 1939.

Subsequent to the staking of the ground an option was taken on the property by D. S. Tait, of Victoria and associates. They did a considerable amount of open-cutting and stripping, but it is understood they dropped this option later in 1939.

The property is approximately 17 1/2 miles north-west of Littlefort (Mt. Olie), a village on the west side of the North Thompson River, 60 miles north of Kamloops. A good highway connects the village with Kamloops. From Littlefort the camp may be reached by following a good motor-road up Lemieux Creek for 9 miles to an abandoned farm known as Dunshek's; it is possible to take a car 2 miles farther, but the way is narrow and partly overgrown by bushes. From Dunshek's there is a good pack-trail for 8 1/2 miles to the camp at an elevation of approximately 4375 feet (based on an approximate elevation for Loon Lake of 4150 feet).

The camp-cabin is approximately a quarter of a mile north-east of the north end of Tin-tl-hoh-tan (Loon) Lake, a small body of water 2 miles southerly from the east end of Taweel Lake. The cabin is 750 feet north-easterly from the north-west corner-post of pre-emption Lot 3431; (See Kamloops Sheet No. 3) procurable from the Dept. of Lands, Victoria, B. C.; and the main working is 1800 feet north of the cabin.

Tin-tl-hoh-tan Lake, or as it will be called in this report, Loon Lake, is on the northern extension of the Tranquille Plateau. In the vicinity of Loon Lake, the plateau is characterized by low, rounded, well-wooded hills, and intervening lakes, swamps and semi-alpine areas. Rock-outcrops are relatively scarce and are found chiefly on the tops of hills and in the small canyons cut by the creeks in the edge of the plateau where the creek grade steepens on entering the Thompson River Valley.

The showings (see Fig. (1)) are on a low, rounded hill that rises to a height of approximately 590 feet above Loon Lake. The hill is densely wooded, but the overburden is not deep. Outcrops are numerous on top of the hill, but less frequent on the side.

The mineral occurrences consist of, a pegmatitic quartz lens heavily mineralized with molybdenite and, many narrow quartz veins only slightly mineralized with molybdenite.

The rock formations which contain the mineral occurrences consist of a small stock of granite and related rhyolite porphyry. The area of granite outcrops measures approximately 2500 feet in a north-westerly direction, by 1500 feet in a north-easterly direction. This granite stock is bounded on at least three sides, the north-east, south-east and south-west, by areas of greenstone. The absence of outcrops north-westerly from the stock prevented determination of the rocks on that side. Nearly continuous outcrops of greenstone occur on a ridge that lies approximately 1000 feet north-easterly from the granite and extends for 1 mile in a north-westerly direction. Scattered outcrops of greenstone occur on the Fourteen-mile Creek slope at points approximately one-half a mile south-easterly from the stock. Continuous outcrops occur on the top of a low hill that lies 1 1/2 miles south-westerly from the stock.

The outcrops of granite on the hill are as shown on Fig. (1). The granite is medium-grained and almost white in colour. Under the microscope this granite is seen to be composed essentially of quartz, microperthite and albite-oligo-

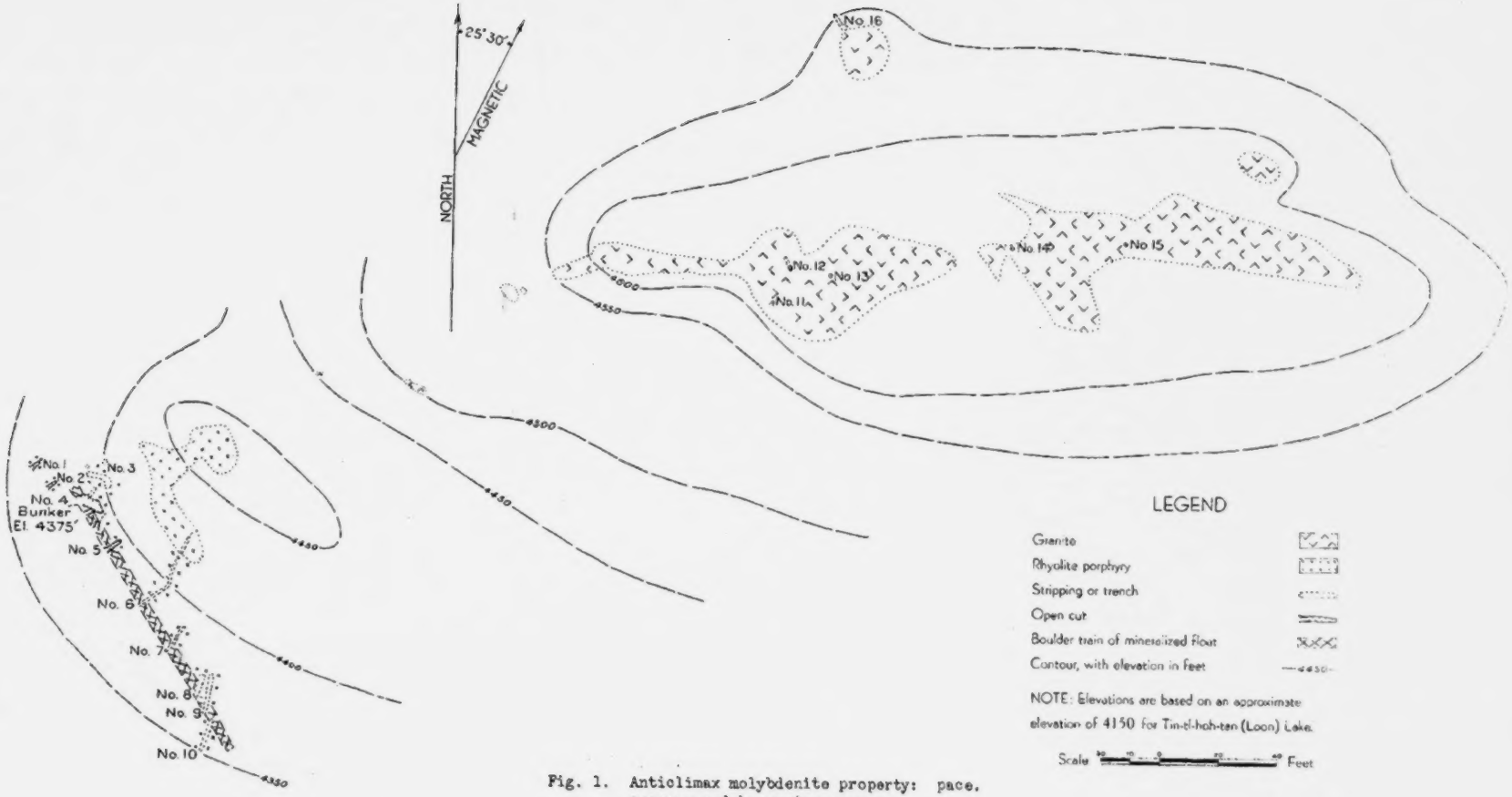


Fig. 1. Anticlimax molybdenite property: pace, compass and barometer survey.

clase. The ratio of potash feldspar to soda-lime feldspar is a little greater than as 5 to 3 which classifies the rock as granite. Because of the almost complete absence of dark minerals and the sodic nature of the plagioclase, this rock could be classed as an alaskite - an alkaline granite with no fenics.

Rhyolite porphyry occurs in the areas indicated on Fig. (1). It is a light-coloured rock in which the quartz phenocrysts, or eyes, are a very conspicuous feature. Under the microscope the rhyolite porphyry is seen to be composed of phenocrysts of quartz, microperthite and albite-oligoclase from 1 mm. to 2.5 mm. in size set in a groundmass of the same minerals.

The relation of the rhyolite porphyry to the granite was not evident in the field. However, the writer interprets the rhyolite porphyry as a border phase of the gently-sloping but definitely upper surface of the granite stock. Definite dyke-like relations to the granite were not found, an irregular and indefinite contact with the granite is indicated by a variation in texture of the rhyolite porphyry that is not uniform in any one direction. This non-uniform variation may be the result of the intersection of the uneven surface of the ground with the irregular contact of the rhyolite porphyry and granite. This contact may tend to conform to the gently-sloping upper surface of the composite granite-rhyolite porphyry stock.

One large, and several small masses of aplite occur in the granite and rhyolite porphyry. A large mass in No. 4 pit appears to strike northerly and dip gently eastward. Within the boundaries of the pit the mass measures 50 feet along the exposed dip-length by 15 feet along the strike by 6 feet across the dip. Smaller bodies of aplite occur in the granite to the west of Nos. 11 and 12 workings. In the outcrop these are crescentic to triangular-shaped areas that range from 2 inches to 2 feet in maximum dimension. Although they have no continuity the aplite masses have sharp contacts against the granite. It is probable that the aplite fills gash-like openings in the granite.

Small irregular patches of pegmatite measuring from a few inches to 2 feet in diameter, occur in the rhyolite porphyry and aplite of No. 4 pit, and in the strippings immediately north-east of the pit. The pegmatite patches are very poorly defined and merge into the surrounding rock. The pegmatite is composed of abundant watery quartz and lesser amounts of potash feldspar; in places, as in No. 4 pit, molybdenite occurs in pegmatite.

The granite is massive and cut by only a few joints. The rhyolite porphyry, on the other hand, is cut by a great number of joints, spaced from 2 to 6 inches apart, which strike north 73 degrees west and dip 80 degrees north-eastward. The only recognisable features are along the north-east side of No. 4 pit. One of these consists only of a paper-thin fracture that follows a joint-plane; the other, is a fracture only 1/4 of an inch in width, that strikes north 30 degrees west and dips 75 degrees south-westward; it definitely cuts the first, but there has been no measurable displacement. Apart from the main ore-lens in No. 4 pit, many narrow veins and stringers of quartz and molybdenite cut the granite to the east of No. 4 pit. These veins strike approximately north 25 degrees west and dip steeply north-eastward. They are discontinuous in length, pinching out to a mere joint within distances ranging from 2 to 20 feet. They represent joints in the granite that have subsequently been filled mainly by quartz.

The mineral-assemblage is definitely high-temperature and closely related to the formation of pegmatites. Medium-grained molybdenite is evenly disseminated in pegmatitic quartz and feldspar and in watery quartz that is adjacent to pegmatitic areas and undoubtedly pegmatitic itself in origin. Small amounts of molybdenite occur elsewhere in narrow quartz veins and stringers that range from 1/2 an inch to 8 inches in thickness. In addition to molybdenite, small amounts of pyrite, sphalerite and fluorite occur in these quartz veins and stringers. It may be noted that the alkaline nature of the enclosing granite and rhyolite porphyry would presuppose small amounts of fluorite present in the accompanying vein-matter. The molybdenite is most abundant where associated with the pegmatite and pegmatitic quartz of No. 4 pit, and is much less abundant in the narrow quartz veins and stringers elsewhere on the property.

The main occurrence of molybdenite is in No. 4 pit. The mineralized lens has been largely removed. However, it is reported to have comprised a gently-dipping lens approximately 8 feet in diameter by 2 feet thick. Remnants of this lens as seen on the north-east side of the pit consist of molybdenite replacing aplite along ill-defined planes that strike north 65 degrees west and dip 25 degrees north-eastward. Remnants of the same lens as seen on the south-west side, consist of an exposure of molybdenite mineralization measuring 8 feet in length by 2 feet in depth by 1 foot in exposed width; in this part of the lens the molybdenite is associated with watery quartz and a small amount of feldspar.

Although the molybdenite of the mineralized lens has sev-

eral mineral-associations, it appears to be most commonly associated with pegmatitic quartz and feldspar. It is found replacing rhyolite porphyry in a few places, more commonly replacing aplite and most commonly associated with the watery quartz and feldspar of pegmatitic patches. In the pegmatite, quartz is much more abundant than the feldspar, and single hand-specimens of the mineralization wrongly suggest that the molybdenite is associated with only quartz. The pegmatitic material occurs as irregular patches, ranging from 6 inches to 2 feet in diameter, and occurs both in the rhyolite porphyry and the aplite.

There is a wide variation in the molybdenite content. A sample taken from a 10-inch specimen of high-grade material in the ore-bin assayed: Molybdenite 10.8 per cent.; another sample from a 12-inch specimen of high grade assayed: Molybdenite 5.8 per cent.

A sample taken across 2 feet of the remnant of the lens as exposed on the south-west side of the pit assayed: Molybdenite 1.4 per cent. A 10-pound sample approximately representative of the ore in the bin assayed: Molybdenite 1.1 per cent. A sample taken across 14 inches of aplite and banded molybdenite in the north-east side of the pit assayed: Molybdenite 0.4 per cent.

The workings will be described in sequence as they are numbered on Fig. (1).

No. 1 has been driven as an open-cut for 22 feet in a direction north 55 degrees east to an 8-foot, caved face. The cut is mostly in overburden, and exposes only a small amount of rhyolite porphyry at the face.

No. 2 is similar to No. 1.

No. 3 consists of irregular strippings that expose a little aplite and two patches of pegmatite in rhyolite porphyry.

No. 4 is the cut in which the mineralized lens was found. It is a large irregular cut measuring 60 feet in a north-westerly direction by 18 feet in a north-easterly direction; the face on the north-east and south-east ranges from 2 to 15 feet in height and the south-west from 1 foot to 3 feet; the north-west end of the cut is open.

No. 4 pit exposes a large body of aplite within rhyolite porphyry. The aplite is exposed in all but the easterly, and

southerly corners of the cut and is a body of at least 6 feet in thickness by 50 feet exposed dip length; it strikes northerly and dips gently eastward. The molybdenite lens and associated pegmatitic material lie almost wholly within this aplite; both are probably genetically related to the aplite. The easterly, and southerly, corners of the cut consist of rhyolite porphyry.

A small fault fracture 1/4 of an inch in width, strikes north 30 degrees west and dips 75 degrees south-westward close to the north-east side of the pit; it cuts the easterly part of the mineralized lens but does not displace it. The fault-fracture is unmineralized and consists only of crushed rock.

All the rock, rhyolite porphyry, aplite and mineralized lens are cut by many unmineralized joints, spaced from 2 to 6 inches apart, and which strike north 73 degrees west and dip 80 degrees north-eastward. The assays of samples taken from the mineralized lens in this pit have been described above.

No. 5 is an open-cut that has been driven in a direction north 57 degrees east for 30 feet. The cut is badly caved and no rock is exposed.

No. 6 is a stripping that exposes only rhyolite porphyry.

No. 7 is in overburden, and sloughing has covered the rock.

No. 8 is a large trench, 6 feet wide that extends in a direction north 20 degrees east for 40 feet across jointed rhyolite porphyry.

No. 9 is a narrow trench 2 1/2 feet wide that extends 75 feet in a direction north 10 degrees east across jointed rhyolite porphyry.

No. 10 trench is in overburden.

No. 11 is an open-cut that has been driven in solid rock in a direction north 20 degrees east for 4 feet to a 7-foot rock-face at the base of a low rock-bluff. The rock is medium-grained granite that contains a small amount of molybdenite and fluorite.

No. 12 is a combined stripping and pit; the stripping is 10 feet wide and extends for 20 feet in a direction south 23 degrees east to the edge of the pit 10 feet square by 6 feet deep. The pit exposes a 1-inch quartz-molybdenite stringer

along the north-east wall. Glacial fluting and striae are well defined in the smooth rock-surface of the stripping; the direction of glacier-movement as indicated by fluting and striae is south 23 degrees east. This direction corresponds very closely with the alignment of ore-float in the boulder-train (Fig. (1)).

No. 13 is a shallow pit 2 feet deep that measures 8 feet in a northerly and 4 feet in an easterly direction. It exposes a short, 1/2 inch stringer in granite; the stringer contains quartz, pyrite, fluorite and a little molybdenite.

No. 14 is an irregular pit in granite. The pit is 2 feet deep and measures 10 feet in an easterly and 4 feet in a northerly direction. A few stringers of quartz, 1 inch wide, follow north-westerly striking joints. A small amount of sphalerite, but no molybdenite, was seen in the quartz.

No. 15 is a pit 4 feet deep and 4 feet square on a quartz vein, 8 to 10 inches wide, that strikes north 13 degrees west and dips 85 degrees south-westward. This vein contains only a little molybdenite. A few small stringers of quartz, pyrite and sphalerite also cut the granite.

No. 16 is a stripping 26 feet long that extends south-easterly to the edge of a large area of granite. The stripping follows a discontinuous, lenticular quartz vein that ranges from 1 inch to 8 inches in thickness. The vein-matter consists of quartz, pyrite and a little molybdenite, sphalerite and fluorite. The rock in the stripping, and adjacent outcrop south-easterly, is all granite except for an isolated dyke-like body of rhyolite porphyry at the south-easterly end of the outcrop. This dyke is 4 feet wide and strikes east.

Further prospecting, if done, should either (1) follow a possible repetition of the mineralized-lens as in No. 4, either down the dip or along the strike, or (2) be in the nature of examination of all float around the periphery of the stock. A repetition of structure similar to that in No. 4 pit is possible and the presence of other lenses might be shown by mineralized-boulders in the float. The source of any float could be determined in a similar manner to that of the No. 4 occurrence, as is described in the following paragraph.

Mineral in place in No. 4 pit was made by following a discovery of molybdenite float to its origin. The float was found on a wooded hillside, so well covered by overburden that prospecting consisted of searching the glacial-till for mineralized

boulders and digging several cross-trenches. The discovery of float was made in the vicinity of trench No. 10 see Fig. (1) and trenches Nos. 10 to 5 inclusive were dug before the outcrop of molybdenite was found in No. 4 pit. Most of this float has been distributed by glacial action. This is shown by the parallelism (see Fig. (1)) between the alignment of the various positions in which the mineralized-boulders were found, that is, the alignment of the boulder-train, and of glacial fluting and striae on outcrops on top of the hill. The direction of the boulder-train as mapped is south 30 degrees east, and that of the fluting and striae is south 23 degrees east; the indicated direction of movement of the ice is from north-west to south-east.

KENALLAN MOLYBDENITE PROPERTY (21)

Ground formerly comprising the Kenallan property has been recently re-staked as a group that includes the mineral claims Numbers 1 to 6, inclusive, and the Oak Fractional. These were staked in August and September, 1939 by R. and F.L. Fitzmaurice, Otto Sandberg and F. W. Groves. This property was examined by the writer in August, 1939.

The property lies approximately 4 miles south-west of Westwold, formerly known as Grande Prairie, a village 35 miles east of Kamloops on the Kamloops-Vernon highway. The property may be reached by following the Westwold-Douglas Lake highway for 4 miles southerly from Westwold, thence by an old logging-road for 1 1/4 miles north-westerly to the property; the logging-road is passable by car for 3/4 of a mile from the highway.

The workings are on the long top and northern slope of an openly-wooded, round-topped hill, the maximum height of which is approximately 300 feet above the end of the passable section of the logging-road.

The Kenallan is a high-temperature replacement deposit in which the original lime and argillaceous sediments have been replaced by lime-silicate minerals and by molybdenite. The molybdenite occurs as a minor constituent in beds of lime-silicate rock. These beds of lime-silicate rock occur in two northerly striking zones. The westerly zone is exposed by surface cuts Numbers 1 to 15 inclusive, and by a short incline on the crest of the ridge. The easterly zone is exposed by an incline and a vertical shaft, workings Numbers 17 and 18, on the eastern slope of the ridge. The length of the westerly zone as exposed by workings, is 1,000 feet, and although the maximum width of the zone is 100 feet, the width of the individual lime-silicate beds ranges from only a few inches to 4 feet.

The length of the easterly zone, as exposed by the incline and vertical shaft, is 150 feet and the maximum width 12 feet; this is also the width of the lime-silicate bed.

Molybdenite occurs almost exclusively within the lime-silicate beds. It is widely scattered and is nowhere concentrated into areas of heavy mineralization. The best material found is that which comprises the dump for No. 6 working, a combined underhand stope and short incline from the bottom of the stope. A 250-lb. sample representative of the dump material, taken by the writer assayed: Molybdenite, 0.5 per cent.; copper, trace; iron, 1.9 per cent.

The rocks associated with the lime-silicate rock are interbedded crystalline limestone and hornfels. The beds range in strike from north 15 degrees west to north 10 degrees east and in dip from 40 degrees to 50 degrees westward. The lime-silicate rock and the limestone range in thickness from a few inches to 4 feet. The entire width of the hornfels was seldom exposed, but widths up to 12 feet have been seen.

The lime-silicate rock is a dense, predominantly light-green rock that contains the following minerals listed in order of abundance: diopside, lime-garnet, epidote, wollastonite and axinite.

The hornfels is a very fine-grained, dark-green rock, that has a slightly brownish hue. It consists of a mosaic of quartz and small amounts of feldspar and biotite.

The limestone is a medium-grained, white rock consisting almost exclusively of calcite.

Towards the north end of the westerly zone, and particularly in the easterly zone, the rocks are cut by diorite sills and tongues. This diorite is a medium-grained rock, containing feldspar and amphibole. The presence of patches of lime-silicate minerals and molybdenite, indicate that although the diorite has intruded the sediments, its intrusion definitely preceded the replacement of these rocks by lime-silicates and molybdenite. The mineralizing solutions, however, probably came from areas of granite, rather than from the diorite. An area of granite outcrops 150 feet north-westerly from No. 15 pit.

Beginning at a point 150 feet north-westerly from No. 15 pit, an area of granite approximately 50 feet wide, extends for 200 feet to the north-west. This granite contains clots of pegmatitic material and on the north-westerly end a lens of

quartz-feldspar pegmatite, measuring 10 feet in a northerly direction and 3 feet in an easterly direction. The granite is medium in grain and varies with the orthoclase content from grey to pink in colour. The composition ranges from that of granodiorite to that of a true granite. This area of granite is bounded by hornfels and crystalline limestone.

The surface workings will be described consecutively, beginning from the southernmost trench on the top of the ridge and proceeding northerly.

No. 1 is a trench 4 feet wide and 4 feet deep that has been driven in a northerly direction for 12 feet. The rocks strike north and dip westward. One foot of grey lime-silicate rock lies in a foot-wall of hornfels. No molybdenite was seen.

No. 2, a shallow stripping 4 feet wide by 2 feet deep, by 10 feet long in a northerly direction, is 90 feet in a direction north 7 degrees east from No. 1. As contrasted to No. 1, the lime-silicate rock lies in the hanging-wall of rusty hornfels. The rocks strike north 15 degrees west and dip 35 degrees westward. No molybdenite was seen.

No. 3, a trench 8 feet long in a northerly direction by 7 feet wide by 3 feet deep, is 45 feet in a direction north 2 degrees west from No. 2. It cuts the following section of rock: 4 feet of limestone in the hanging-wall, then 3 feet of lime-silicate rock, then 2 feet of rusty hornfels. No molybdenite was seen.

No. 4, a trench driven 28 feet westerly across the strike of the rocks to a 4-foot face, is 75 feet in a direction north 5 degree west from No. 3. The trench exposes 3 1/2 feet of limestone on the hanging-wall, and 3 feet of green lime-silicate rock in the foot-wall, some of which contains abundant fine-grained epidote, and then 6 feet of hornfels. A small amount of molybdenite and chalcopyrite were seen admixed with dark-brown crystalline garnet.

No. 5, an irregular pit 5 feet deep measuring 25 feet in a northerly direction and 15 feet in a westerly direction, is 60 feet in a direction north 10 degrees west from No. 4. The same succession of rocks occurs as in No. 4. In this pit the limestone bed is decidedly lenticular. A small amount of purple axinite was seen in the lime-silicate. The only molybdenite seen was in a small dump at the side of this pit.

No. 6, an open-cut driven 20 feet westerly, is 60 feet in a direction north 10 degrees west from No. 5. From the

west end of this cut a drift-working extends 25 feet southerly, and from the floor of this drift-working, an underhand-stope extends down the dip of the sediments for 15 feet. The stope is in a 42-inch band of lime-silicate rock, with 4 feet of limestone in the hanging-wall and hornfels in the foot-wall. These rocks strike north 15 degrees west and dip 40 degrees westward.

Only a little molybdenite was seen in the present faces, but a considerable amount of molybdenite-bearing rock estimated at approximately 100 tons has been taken from the drift-working and incline, as indicated by a nearby dump.

The writer sampled this dump by taking representative pieces of ore from various places on and in the dump. A 250-pound sample of this material was sent to the Department of Mines Sampling Plant at Prince Rupert for crushing and reduction. The sample assayed: Molybdenite, 0.5 per cent.; copper, trace; iron, 1.9 per cent.

No. 7, a stripping that follows the same lime-silicate bed as the drift in No. 6 working, but here the beds strike north, is 60 feet in a direction north 60 degrees west from west end of the open-cut at No. 6. Eight feet westerly from No. 7 a second stripping exposes a lime-silicate bed 4 feet thick. The succession of rocks to the east of this stripping is; limestone, 2 feet; lime-silicate rock, 4 feet; limestone, 2 feet; lime-silicate, 3 feet; hornfels. A small amount of molybdenite was seen.

No. 8, a trench 4 feet deep measuring 35 feet in a northerly direction and 5 feet in width, is 70 feet northerly from No. 7. This trench appears to be in the western bed of lime-silicate that extends from No. 7; 3 feet of limestone overlies the lime-silicate. The beds strike north 10 degrees east and dip 45 degrees westward. A slight bend to the east seems to have occurred in the rocks between No. 7 and No. 8. Only a small amount of molybdenite was seen.

No. 9, a pit 8 feet deep and 4 feet in diameter, is 90 feet in a direction north 30 degrees east from No. 8. The rocks in this pit strike north 10 degrees west, and dip 50 degrees westward; they are bounded on the south by a vertical fault that strikes north 60 degrees east. The continuation of the lime-silicate beds northerly from No. 8, appears to be offset in an easterly direction towards the position of No. 9 pit. The succession of rocks in No. 9 from west to east is: lime-silicate rock, 2 feet; hornfels, 2 feet; diorite sill, 14 inches; hornfels, 3 feet.

No. 10, a trench 3 feet deep, measuring 15 feet in an easterly direction and 4 feet in width, is 40 feet in a direction north 30 degrees west from No. 9. A small patch of hornfels is exposed in the western end.

No. 11, a pit 3 feet deep and 6 feet in diameter, is 70 feet in a direction north 40 degrees east from No. 10. From west to east it exposes 1 foot of limestone, 3 feet of lime-silicate rock and then hornfels.

No. 12, a pit 2 feet deep and 5 feet in diameter, is 100 feet northward from No. 11. From west to east the succession is: 2 feet of lime-silicate rock; 12 feet of limestone; and 3 feet of lime-silicate rock. Wollastonite was seen in this pit.

No. 13, a pit 4 feet deep and 5 feet square, is 175 feet in a direction north 5 degrees east from No. 12. The rocks strike north 4 degrees east and dip 45 degrees westward. From west to east the succession is: 6 inches of lime-silicate; 12 inches of diorite; 5 feet of lime-silicate rock; and then hornfels. Although the diorite is definitely intrusive into the associated rocks, it has been in part replaced by lime-silicates and by molybdenite.

No. 14, a pit 2 feet deep and 5 feet in diameter, is 40 feet in a direction north 25 degrees east from No. 13. The rocks are similar to those in No. 13.

No. 15, a trench that extends 10 feet south-westerly, is 50 feet northerly from No. 14. This trench cuts across 2 feet of diorite, 3 feet of hornfels and some lime-silicate in the foot-wall.

In general, workings No. 1 to 15 inclusive, follow one westerly zone, of lime-silicate beds. However, this westerly zone can be sub-divided into possibly five separate lime-silicate beds; one bed is exposed by Nos. 1 to 7 inclusive, a second by Nos. 7 and 8, a third by Nos. 9 and 10, a fourth by Nos. 11 and 12, and a fourth and fifth by Nos. 13 to 16 inclusive. The maximum width of the zone of lime-silicate beds is 100 feet; but the individual beds range from only a few inches to 4 feet.

No. 16, a trench 15 feet long in an easterly direction, is 360 feet in a direction north 42 degrees west from No. 15. It extends across the northern end of a pegmatite lens 10 feet long by 3 feet wide; the pegmatite contains only quartz and pink feldspar.

No. 17, an incline sunk on a 40-degree slope in a westerly direction for 9 feet, is 400 feet in a direction north 85 degrees east from No. 15. This incline measures 12 feet in a northerly direction and extends as an irregular stripping for 50 feet to the south. The rocks in this incline consist of hornfels and cross-cutting tongues of diorite; only a few patches of lime-silicate rock and a little molybdenite were seen.

No. 18, a shaft, 12 feet in diameter that is now filled with water and inaccessible, is 150 feet northward from No. 17. It has been sunk entirely in lime-silicate rock. Only small amounts of molybdenite were seen.

SANDS CREEK MOLYBDENITE (24). The Sands Creek molybdenite occurrence and adjacent ground appears to be covered by the No. 1 and No. 2 Sands Creek Molybdenum claims staked on April 21, 1939 and owned by Gordon and I. A. Bennett of Clearwater, and, by the Morning Star claim, staked on December 30, 1939 and owned by J. L. Carden. The writer examined this occurrence in June, 1938.

The occurrence is a small showing of molybdenite that occurs in the south bank of Sands Creek; a small creek that flows westerly into the Clearwater River and crosses the Clearwater road at a point about 1 1/2 miles back or to the north of the main North Thompson highway near Clearwater Station, (Canadian National Railway) about 76 miles north of Kamloops. The showings are 700 feet down-stream from the road crossing. This property has been briefly described by Walker in the Summary Report, Geological Survey of Canada, 1930, Part A, p. 153-A.

The workings consist of a little blasting on three quartz lenses in the bank of the creek. Two of these are close to the top of the 30-foot bank and the third is halfway down the bank at the base of a 15-foot rock bluff that extends down from the upper showings.

The uppermost showing is a lens of barren quartz, 6 feet long by 18 inches thick in its thickest part, that strikes north 70 degrees east and dips 7 degrees southward.

At about the same level in the bank and 20 feet easterly, a 4-foot zone of quartz stringers cuts aplitic granite. These stringers, strike north 70 degrees east and dip 60 degrees southward and carry a small amount of molybdenite. A sample taken across the zone assayed: Molybdenite, 0.1 per cent.

A short distance below the quartz lens first described, a third showing containing a small amount of molybdenite, extends diagonally north-easterly down the bank of the creek for approximately 20 feet. This quartz strikes north 50 degrees east and dips 80 degrees southward, and ranges in width from 3 inches to 8 inches. A sample taken across 6 inches of vein-matter near the upper end assayed: Molybdenite, 0.3 per cent, and one consisting of selected dump-material assayed: Molybdenite, 0.78 per cent. This occurrence is in coarse-grained granite similar to that of the second showing.

BOSS MOUNTAIN (25). The Boss Mountain Molybdenite property on Boss Mountain (Big Timothy Mt.), in the Quesnel Mining Division, includes the Crown-granted mineral claims, Tooty Fruity, Geraldine, Blacky, Utoo, Adanac, Bonnie, Adanac No. 2, Tip Top, Adanac Fraction and Adanac No. 1; these claims were located at various times between 1928 and 1935, and are at present owned by the Consolidated Mining and Smelting Company of Canada, Limited of Tadanac, British Columbia. The property was examined by the writer in July, 1937.

Boss Mountain (Big Timothy Mt.) (Plate I B) at longitude 120 degrees 56 minutes and latitude 52 degrees 06 minutes north, lies approximately 45 miles north-east of Lac la Hache.

The Boss Mountain area may be reached by at least three different routes, but the best is by 25 miles of poor motor-road, passable by cars with good clearance, from Lac la Hache (elevation 2,650 feet) on the Cariboo Highway, to the Eagle Lake Ranch on the western end of Murphy (Eagle) Lake, (elevation 2,875 feet), thence by pack-horse trail for approximately 20 miles to the pass over Boss Mountain, at an elevation of 6,750 feet, and down to the camp-cabin at an elevation of 5,550 feet on the south-easterly side of the mountain. The camp-cabin is on the northern bank of the eastern headwater tributary of Molybdenite Creek. This tributary flows to the north into McKinley Creek and thence into the Horsefly River.

The two other routes are (1) via a pack-horse trail that leads from Vaughan's ranch (Pre-emption Lot No. 104 on Quesnel Sheet, Map No. 3-G, procurable at Dept. of Lands, Victoria), now abandoned, 8 miles along the road to the north from Lac la Hache, north-easterly past the east end of Spout Lake, by Geo. Borthwick's ranch (Pre-emption Lot No. 9105 on Quesnel Sheet) on the east end of Murphy (Eagle) Lake, thence north-easterly to the property, and (2) by pack-horse trail to the north from Forest Grove, a village 9 miles east of Canim Lake, to Geo. Borthwick's ranch (Pre-emption Lot No. 9105 on Quesnel Sheet),

thence north-easterly to the property. Hunting parties have approached Boss Mountain along a route that follows Boss Creek directly to the north from the west end of Canim Lake; this route is possibly better than the others because of its shorter length and the reported absence of swamps. As yet, no well-defined pack-trail has been built.

The showings are on both sides of a small creek flowing easterly into Molybdenite Creek. The south side of the creek-valley rises steeply from the creek bank and is covered by drift and a dense growth of timber; 600 feet above the creek the slope eases and the dense timber gives way to more alpine country consisting of grassy slopes and rock-exposures. The workings on this side of the creek extend from an elevation of 5,600 feet near the creek to an elevation of 6,100 feet. The north side of the creek-valley slopes gently back for 1/4 of a mile before it begins to steepen; the workings on this side are in the creek banks, on this gently-sloping ground and on a small area of flat ground on the south side. The accompanying sketch (Fig. 2), shows their distribution. South-westerly from the workings the creek heads in a precipitiously-walled cirque. From its base at a point about 1,000 feet upstream from the cabin the cirque rises steeply for approximately 1,100 feet to the gentle slopes of the upland area.

The molybdenite deposit consists of (1) quartz veins mineralized by molybdenite, and (2) a circular area of fractured quartz diorite mineralized by quartz and molybdenite.

The rock in the vicinity of the showings is quartz-diorite that forms part of a large batholith of granitic rocks that is about 30 miles in diameter. The showings are approximately 5 miles from the eastern contact of the batholith with a north-westerly trending belt of older greenstones nearly 5 miles in width. Olivine basalt and agglomerate of Tertiary or post-Tertiary age cap the two summits of Boss Mountain which lie roughly 1 1/2 miles north-easterly from the molybdenite showings.

At various places, particularly in the vicinity of the Creek Showings (Fig. 3), the quartz-diorite contains light-grey inclusions of feldspathized rock. These feldspathic inclusions possess a typical sugary, hornfels texture indicative of re-crystallization of the original rock, presumably a greenstone, by the contact action of the enclosing quartz-diorite.

The rocks on the property, other than quartz-diorite, include aplite, pegmatite, quartz-porphyry and lamprophyre. Two outcrops of fine-grained, sugary aplite were seen, which con-

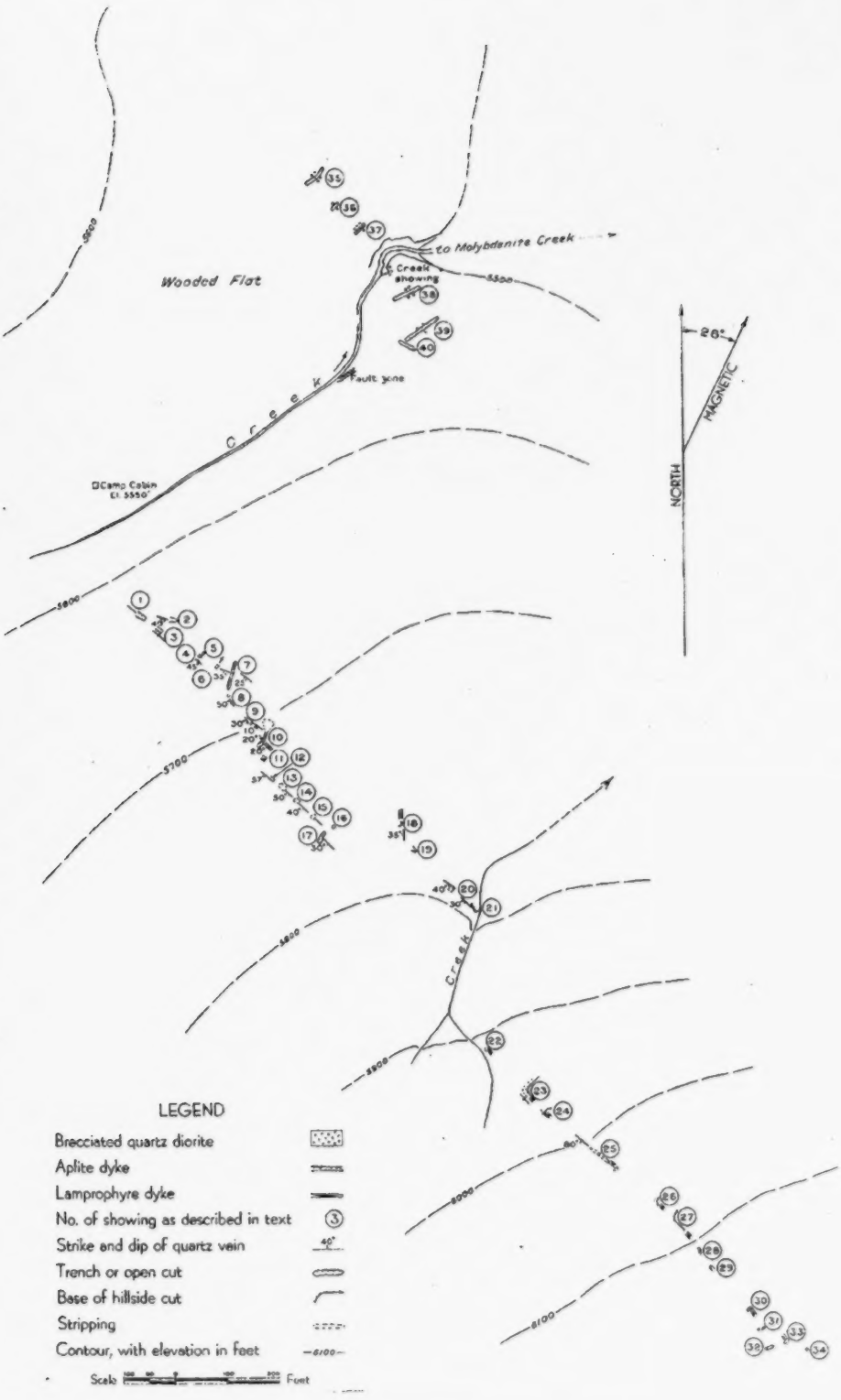


Fig. 2. Consolidated Mining and Smelting Company molybdenite property, Boss Mountain. General plan of workings. Tape, compass survey.

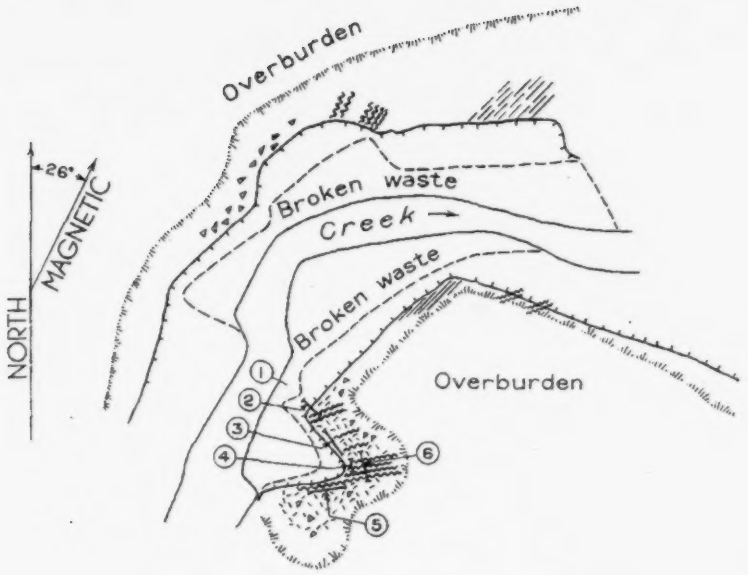
stitute parts of a dyke approximately 3 feet wide in showing No. 18 (Fig. 2). Pegmatites have been reported from the hillside lying north-westerly from the camp-cabin, but on the south-easterly side and in the Creek Showings the writer was able to find only small pegmatite veinlets of pink orthoclase and quartz. One-quarter of a mile down-stream from the Creek Showings, a 4-foot dyke of quartz-porphyry, striking south-easterly and dipping 40 degrees south-westward, occurs on the south side of the Creek.

Parts of a dark-green, lamprophyre dyke, consisting of hornblende and biotite were seen on the south-easterly hillside; it extends to the south-east of showing No. 22 up the hill to No. 31, and for most of the distance on the north-east wall of a quartz vein; the maximum width observed was 5 feet. Although the patchy distribution of the dyke as seen in the cuts along the strike, suggests that the lamprophyre occurs as inclusions in the quartz-diorite, the presence of off-shoots of the lamprophyre from the main mass into the quartz-diorite points to a somewhat later age. It is suggested that (1) the dyke may have been emplaced at a late stage in the crystallization and intrusion of the batholith, and at a time before all movement of the magma had ceased, or that (2) the dyke may have filled gash-fractures in the quartz-diorite after all crystallization had ceased and the mass had become solid.

The molybdenite occurrences on the property belong to two closely-allied structural types. One type consists of quartz veins that fill tension-fractures and the other a quartz-diorite breccia cemented by quartz and molybdenite; molybdenite occurs in both types.

The quartz veins are variable in width and discontinuous along the strike. In width they range from a knife-edge to 2 1/2 feet and in length from 3 to 56 feet; this last figure represents the longest continuously-exposed section of any one vein seen. It is possible that disconnected exposures aligned between showings No. 23 and 32 (Fig. 2) over a length of 250 feet, represent parts of the same vein. The greater number of the veins range in strike from north 70 degrees west to north 50 degrees west, the latter strike being the prevalent one, and range in dip from 25 degrees to 80 degrees south-westward. The exposures and probably by far the greater number of veins, occur within a belt 150 feet in width that trends to the south-east up the hillside for approximately 2,000 feet from the camp-cabin (Fig. 2).

In most of the veins, massive quartz is the main vein-filling. However, in some veins, particularly along their borders, angular inclusions of wall rock are abundant; these



LEGEND

- Massive quartz diorite
- Area in quartz diorite, marked by an abundance of basic inclusions
- Area of abundant molybdenite in brecciated quartz diorite
- Base of rock cut face
- Top of creek bank
- Fault, marked by gouge, crushed rock and ore
- Joints in quartz diorite

Scale 20 10 0 20 40 Feet

Sample No.	Width	% MoS_2	Description.
1	Grab	2·7	Good grade breccia from ore dump
2	56"	3·0	Across seams of MoS_2 and quartz
3	56"	3·4	Solid breccia 3·4 seams of MoS_2 and yellow oxide
4	30"	3·5	In north portion of fault zone, abundant MoS_2 and yellow oxide
5	72"	2·0	Crushed fault zone material, rock, MoS_2 and yellow oxide
6	70"	2·4	Across solid breccia, mineralized by MoS_2

Fig. 3. Consolidated Mining and Smelting Company molybdenite property, Boss Mountain. Detail of creek showings. Tape, compass survey.

inclusions are mostly quartz-diorite, but in areas where lamprophyre dykes occur they may be fragments of the dyke. A ribbon-texture in the vein-quartz occurs in parts of showing No. 25; this texture is characterised by thin films of fine-grained molybdenite in parallel fissures that themselves parallel the strike of the vein. The zones of such ribbon-texture are discontinuous along the strike and probably represent an incipient parallel fracturing of the vein rather than marked shearing within it.

Quartz-diorite, conspicuously brecciated and the fragments sealed by quartz and abundant molybdenite, (Plate II B) occurs within an area 20 feet in diameter in the Creek Showings (Fig. 3). The brecciation extends north-westerly and south-westerly for a distance, as exposed in trenches, of 350 feet, but the intensity of the brecciation is much decreased and the amount of molybdenite small. The breccia fragments are very angular in outline and range from 1/2 an inch to 6 inches in maximum dimensions.

The area of intense brecciation presumably forms the central part of an ore-chimney or breccia-pipe. It would, therefore, be expected to extend farther vertically than horizontally. Where no structural reason is evident, the characteristic fracturing of a breccia-pipe is considered to have resulted from the explosion of water vapour and other vapours collecting at certain points under increasing pressure during the cooling and crystallization of a batholith. Breccia-pipes have been widely discussed in literature, the most recent descriptions being those by Emmons (1935, 1938) and Perry (1933) (see Bibliography at end of Bulletin).

The filling of both the veins and the breccia is chiefly quartz. Molybdenite occurs in varying amounts from traces to as much as 3.5 per cent., as shown by the accompanying assays. The molybdenite commonly occurs as films of blades arranged normal to the walls of a vein or to the outlines of included rock-fragments; the films range from 1/32 to 1/2 an inch in width; less commonly it occurs as thin ribbons of very fine-grained molybdenite imparting a ribbon-texture to the vein, as in showing No. 25. The canary-yellow oxidation product, the hydrated ferric molybdate, molybdite, is common on the surface of the veins or in the shear-zones of the Creek Showing. A small amount of chalcopyrite and pyrite occurs in both the veins and the breccia. Occasional crystals of pink orthoclase, ranging from 1/8 to 1/2 an inch in size occur in both the veins and breccia; these are always associated with the molybdenite either on the borders of the veins or surrounding rock-fragments, indicating that they formed early in the sequence of

mineralization. The mineral relations suggest that a considerable amount of vein-quartz formed subsequently to the deposition of both the orthoclase and molybdenite. The occurrence of small amounts of orthoclase suggests the close affinity of the vein-matter in both the quartz veins and breccia to pegmatites, and its formation represents a stage in separation of volatiles from the magma chamber immediately succeeding the pegmatite stage.

Fracturing of the quartz-diorite may be grouped according to the way it has allowed for the emplacement of (1) aplite in fractures of two directions, north and north-easterly; (2) a lamprophyre dyke in a north-westerly striking fracture; (3) the quartz as veins in discontinuous fractures striking predominantly north-westerly and dipping south-westward; (4) quartz as cementing material for the brecciated quartz-diorite of the Creek Showing. In these pre-mineral fractures there has been no shearing, and this condition, combined with the characteristic brecciation of the wall rock, indicates that the pre-mineral fractures are simple tension-fractures, as opposed to the shears.

The post-mineral faults or shears are characterised by abundant crushed rock and gouge, which is evidence of a considerable amount of shearing within the fracture-zones. Faults or shears are not common in the vicinity of the quartz veins. Two small faults were seen in the adit or showing No. 10 (Fig. 2). Post-mineral shearing has been intense in the breccia of the Creek Showing. Most of the shearing is confined to two east-westerly striking zones of crushed rock and gouge ranging from 1 foot to 4 feet in width. A wide fault-zone striking north 60 degrees east and 5 feet in width, cuts the quartz-diorite on the south-eastern side of the creek approximately 250 feet up-stream from the Creek Showing (Fig. 3).

The first record of molybdenite on Boss (Big Timothy) Mountain is in the Annual Report Minister of Mines, British Columbia, for 1917, p. 134, which states,

> "During 1917 exposures of molybdenite were discovered by Ryan and claims were staked covering them."

During the following year development work was done by Ryan and Hamilton. Apparently little was done between then and 1930, when the property was bonded by the Consolidated Mining and Smelting Company and a considerable amount of work done on the trail. Since then farther surface exploration has been carried on by this company.

The workings on the property comprise numerous open-cuts and strippings and one short adit; their distribution is shown on Fig. (2). Caved cuts, or those showing no rock, are not shown on Fig. (2). The workings will be described in two groups, one, those up the hillside south-easterly from the camp-cabin and those on the banks of the creek north-easterly down-stream from the cabin, known as the Creek Showing.

No. 1 cut has been driven south 55 degrees east for 20 feet through disintegrated quartz-diorite. Two lenses of quartz are exposed, one, on the south-westerly wall, that measures 1 foot by 3 feet, and the other in the back at the face measuring a few inches by 3 feet. None of these show any molybdenite, although fragments of quartz containing molybdenite were seen on the dump.

No. 2 is a shallow cut that has been driven south 75 degrees east for 12 feet through quartz-diorite. The cut exposes a relatively flat quartz vein on the north wall, that ranges from 2 to 3 inches in thickness, and contains a thin sheet of molybdenite on both walls.

No. 3 cut has been driven south 55 degrees east for 16 feet. From 10 feet to the face, a lenticular vein of quartz mineralized with a small amount of molybdenite on the north-easterly wall, outcrops in the floor; this vein is vertical and ranges from 8 inches in width at the floor to 18 inches at the top of the cut. The rock on the west wall of the vein is quartz-diorite and on the east wall it is part of a greenstone inclusion.

No. 4 is a stripping that has been driven south 65 degrees east for 20 feet. The floor on the southern end exposes a curving quartz lens 5 feet long by a few inches wide that pinches out on both ends. It strikes south-easterly and dips 45 degrees south-westward; and contains a little molybdenite on the hanging-wall.

No. 5 is an irregular stripping approximately 10 feet in diameter that exposes an area of quartz-diorite inclusions in vein-quartz, 5 feet in diameter, and on the west wall a 2-inch stringer of quartz that has a ribbon of molybdenite 1/2 an inch wide on both walls over a length of 2 feet. The molybdenite crystals are conspicuously normal to the walls of the stringer.

No. 6 is a square stripping approximately 10 feet on the side that exposes an area of brecciated quartz-diorite sealed and cut by vein-quartz; the two main quartz lenses of this showing strike north-westerly and north-easterly. Only one small

film of molybdenite was seen in this material.

No. 7 is a trench that has been driven north 15 degrees east for 60 feet in quartz-diorite. Twelve feet from the northern end a barren quartz vein outcrop strikes north 55 degrees west and dips 25 degrees south-westward.

No. 8 is a small sidehill cut that exposes a lens of quartz 3 feet thick by 4 feet long, striking north 15 degrees west and dipping 50 degrees south-westward; the lens contains only a little molybdenite.

No. 9 is a sidehill stripping with its long axis striking south 45 degrees east for a length of 21 feet. A strong but barren quartz vein 12 inches wide, exposed on the north-easterly side of the stripping, strikes north 70 degrees west and dips 10 degrees south-westward. Westerly from this vein there are two small areas of brecciated quartz-diorite sealed by quartz, but containing no molybdenite.

No. 10 working is a combined open-cut and short adit. The open-cut has been driven south 10 degrees west for 15 feet, and south 40 degrees west for 14 feet to the portal of the adit; the adit has been driven south 40 degrees west for 14 feet to the face. For 7 feet out from the portal of the adit the open-cut intersects a zone of quartz-veins. This zone contains three quartz-veins, striking north 50 degrees west and dipping 20 degrees south-westward, that range from 2 to 12 inches in width; several smaller parallel stringers occur between these main veins. Discontinuous fringes of molybdenite occur on the walls of these quartz-veins. Occasional narrow veins of crushed rock indicate that there has been a slight post-mineral movement along the veins. A flat fault near the face of the adit has displaced the veins 3 feet to the west.

No. 11 working is an old shaft 5 feet wide by 8 feet deep. Close to the bottom in the north-westerly wall of this shaft there is a lens of barren quartz, 8 feet long by 2 feet thick, striking north 40 degrees west and dipping 30 degrees south-westward. The south wall of the shaft is marked by closely-spaced joints in the quartz-diorite that strike north-easterly and dip 80 degrees south-eastward.

No. 12 is a cut that has been driven south 50 degrees east for 11 feet. The face of the cut exposes a quartz lens 28 inches thick which strikes north 50 degrees west and dips 55 degrees south-westward. The lens contains a few small fragments of quartz-diorite in the hanging-wall; each fragment is bounded by a fringe of molybdenite. A sample taken across 28

inches assayed: Molybdenite, 6.0 per cent.

No. 13 is a rectangular stripping 10 feet by 15 feet that exposes a 9-foot length of a quartz lens 2 to 3 feet thick, that strikes north 45 degrees west and dips 50 degrees south-westward. Numerous angular inclusions of quartz-diorite occur in the hanging-wall of the lens. A few small quartz lenses cut the quartz-diorite 5 feet west of the main lens. There is very little molybdenite in this showing, and the material in a pile on the north-easterly side of the stripping, contains but little molybdenite.

No. 14 is a stripping 10 feet square that exposes a lens of quartz 5 feet wide by 6 feet long that strikes south 50 degrees east and dips 40 degrees south-westward. This quartz lens contains numerous angular inclusions of quartz-diorite that are fringed by molybdenite crystals growing normal to the facies of the fragments. The surface of the quartz is marked by numerous blade-like gashes that indicate the location of blades of molybdenite which have weathered. A sample taken across 5 feet of vein-matter and including five 1/2-inch fringes of molybdenite, assayed: Molybdenite, 6.0 per cent. A sample taken from an ore-dump that evidently represented hand-sorted materials assayed: Molybdenite, 8.6 per cent.

No. 15 is a stripping 8 feet by 15 feet that exposes a triangularly-shaped quartz lens 6 feet long by 1 foot wide, that is apparently a continuation of the quartz in the last stripping; this lens contains only a few flakes of molybdenite.

Showing No. 16 comprises two very short trenches each of which contains a short stringer of quartz containing very little molybdenite.

No. 17 is a sidehill stripping 36 feet long that exposes two quartz-veins ranging from 6 to 18 inches in thickness that strike north 50 degrees west and dip 30 degrees south-westward. They are bordered in part by 1/4-inch fringes of molybdenite. The rock is quartz-diorite.

No. 18 is a cut 10 feet long that exposes a 2-inch quartz vein, strike north dip 35 degrees west, with 1/4 to 1/2-inch fringes of molybdenite on its walls. It lies in a 3-foot aplite dyke of similar attitude and strike.

No. 19 is a cut that has been driven southerly into the hillside for 15 feet. A short lens of quartz, 2 feet long by 6 inches wide, occurs close to the face; it contains a small amount of molybdenite. Fragments of aplite in quartz-diorite

were seen in both walls of the cut.

No. 20 cut, driven south 65 degrees west for 15 feet, badly sloughed, but exposes part of a 12-inch quartz lens that strikes north 50 degrees west and dips 40 degrees south-westward; the quartz contains a small amount of molybdenite.

No. 21 is a sidehill stripping that extends 24 feet north-westerly from the west bank of a small creek. It exposes a quartz-vein 3 to 6 inches in width that strikes north 50 degrees west and dips 30 degrees south-westward. The vein cuts quartz-diorite and a 6-foot vertical aplite dyke that strikes north 55 degrees east.

No. 22 is a short cut, almost completely sloughed, but it exposes part of fine-grained, dark-green, lamprophyre dyke consisting almost wholly of hornblende and biotite.

No. 23 is a sidehill stripping and cut that exposes on its south-westerly face a 9-foot length of quartz, 15 inches in thickness that strikes north-westerly. No molybdenite was showing. A 5-foot width of the dark-green, lamprophyre dyke exposed in No. 22 lies on the east side of the vein; elsewhere the rock is quartz-diorite.

No. 24 is also a sidehill stripping and cut that exposes what is probably the extension of the quartz vein from No. 23; here the quartz is 12 inches wide, and contains very little molybdenite. A 3-foot width of the green, lamprophyre dyke is exposed adjacent to the east side of the vein.

No. 25 is a stripping that extends for 56 feet south-easterly up the hillside and exposes a continuous section of a quartz-vein that ranges from 8 inches to 2 1/2 feet in width, strikes north 45 degrees west and dips 80 degrees south-westward. The foot-wall part of the vein is ribboned by thin films of very fine-grained molybdenite; elsewhere the quartz is massive. In general, the molybdenite in this vein is finer-grained than that seen elsewhere on the hillside. The vein, occurring as an elevated rib, is the only material exposed in the stripping, except for some inclusions of the lamprophyre dyke and quartz-diorite; the presence of these inclusions indicate that the vein is later than the lamprophyre dyke. The following samples were taken across the vein: one across the full 2 1/2-foot width of vein at a place 25 feet from the north end, assayed: Molybdenite, 1.3 per cent., and another from the same place across 6 inches of high-grade material in the hanging-wall assayed: Molybdenite, 2.5 per cent.; a third sample taken across the full 2 1/2-foot width of the quartz vein at

a point 8 feet from the south end, assayed: Molybdenite, 1.4 per cent.

No. 26 is a sidehill cut and stripping that exposes only quartz-diorite and thin patches of the green dyke on the westerly wall.

No. 27 is a similar cut and stripping exposing quartz-diorite and patches of green dyke, but no vein-matter.

No. 28 is a short cut that exposes quartz-diorite, but no vein-matter. The quartz-diorite contains a few hornfels inclusions and in one place is cut by a 1-inch veinlet of epidote.

No. 29 is a stripping 12 feet long that exposes a vertical quartz lens 1 foot wide that strikes north 37 degrees west; the quartz contains a little fine-grained molybdenite and paper-thin inclusions of the green dyke.

No. 30 is a short trench that exposes only the green lamprophyre dyke, here 1 foot wide.

No. 31 is a short trench exposing only quartz-diorite.

No. 32 is a short trench exposing quartz-diorite and a stringer of quartz 1 inch thick.

No. 33 is a short trench exposing quartz-diorite and a part of green lamprophyre dyke 1 foot thick; offshoots of the dyke were seen to extend into the quartz-diorite.

No. 34 is a short trench that exposes only quartz-diorite.

The best showing of molybdenite is the one known as the Creek Showing (Fig. 3), approximately 800 feet down-stream from the camp-cabin. In an area approximately 20 feet in diameter on the east bank of the creek (Fig. 3), the quartz-diorite has been intensely brecciated and the fragments sealed by molybdenite, orthoclase and quartz (Plate II B). This mineralized breccia has been cut by post-mineral faults, the fault-zones being marked by crushed rock and mineral matter; much of the molybdenite in the crush zones has altered to the canary-yellow, hydrated ferric molybdate, molybdite. The quartz-diorite here and to the north across the creek-bed contains numerous feldspathesized greenstone inclusions: these are in various stages of absorption or feldspathization by the quartz-diorite and as a result range in colour from dark-grey to a light-grey, which is only slightly different from the general

colour of the main rock-mass.

The molybdenite occurs mainly as rims surrounding rock-fragments (Plate II B). Less frequently it occurs in the quartz forming the matrix for the breccia or in quartz-molybdenite veinlets cutting the rock mass. In the ground exposed, the best development of molybdenite is confined to the 20-foot area of intense brecciation which is shown by the area sampled in Fig. (3). Only small amounts of molybdenite occur to the north across the creek or in the trenches that lie north-westerly and south-easterly from the Creek Showing. It is probable that the area of most intense brecciation constitutes the central part of a breccia-pipe, and, therefore, has a vertical extent greater than its horizontal.

The faults and accompanying fault-zones are post-mineral in age and as such have no causal relation to the emplacement of the molybdenite. The quartz-molybdenite solutions probably rose through the brecciated quartz-diorite, the brecciated fragments inducing precipitation of the molybdenite and orthoclase as is indicated by the frequent occurrence of molybdenite and orthoclase as rims around the rock-fragments. The grade of the ore in the Creek Showing is shown by the table of assays on Fig. (3).

Trenches have been dug on both sides of the creek in the vicinity of the Creek Showing, but so far have failed to uncover an area of brecciated quartz-diorite containing molybdenite similar in amount to that found on the eastern side of the creek in the Creek Showing.

Showing No. 35 is a trench 45 feet long exposing a zone of breccia 10 feet wide in quartz-diorite. The brecciation in this zone has been slight and the amount of quartz and molybdenite is correspondingly small.

Showing No. 36 is a trench 20 feet long, exposing a slightly brecciated zone approximately 20 feet wide, the south-westerly 5 feet of which contains numerous veinlets of quartz; only a little molybdenite occurs here.

Showing No. 37 is a trench 30 feet long. The rock in this trench is badly weathered, but it appears to be slightly brecciated; quartz occurs as veinlets and irregular areas in the breccia. Neither molybdenite nor molybdite are abundant. A sample taken across 3 feet at the north-east end of the trench assayed: Molybdenite, 0.3 per cent. and one across 3 feet at the south-west end assayed: Molybdenite, 0.2 per cent.

Showing No. 38 is a trench 60 feet long which exposes a breccia zone approximately 20 feet wide, the fragments of which are sealed by quartz and a little molybdenite.

No. 39 is a trench 80 feet long. The quartz-diorite in this trench contains an abundance of basic inclusions in varying stages of absorption. The assemblage is cut by quartz-veinlets, and in one place, by a pegmatite veinlet 1/2 an inch wide. Very little molybdenite occurs in this trench.

No. 40 is a trench 40 feet long that exposes quartz diorite cut by quartz veinlets, and late orthoclase stringers. No molybdenite was seen here.

It is reported (Wilmot, 1935, p. 49) that the production to date has consisted of 1,000 pounds of picked ore from which 350 lbs. of molybdenite was recovered. There has been no production in recent years.

The Creek Showing offers the best chance for the development of an ore-body. In support of this statement, the writer suggests that the area of intense brecciation in this showing may form the central part of an ore-chimney or breccia-pipe. The work done to date (July, 1937) is all surface work and as such does not supply data which may aid in determining either (1) whether such a pipe exists or not, or (2), if the pipe exists, what its configuration is with depth. The pipe may increase, decrease, or remain constant in diameter with depth.

As an aid in determining the structure, diamond-drilling is suggested as the best type of future, preliminary exploratory work. Several 45-degree holes directed radially towards the centre of the area of intense brecciation would give determinative information.

BENTHAM MOLYBDENITE PROSPECT. (30)

This prospect consists of the Molly Nos. 1 to 8 mineral claims staked in 1937 by T. Bentham, and owned by Bentham and associates of Powell River, B. C. The writer examined this prospect in September, 1939.

The showings are on the north-west side of Haslam Lake, a small lake lying about 6 miles east of Powell Lake. Haslam Lake may be reached from the town of Powell River by following the Cranberry Lake road south-easterly for 2.6 miles and thence by a branch road to the east for 1.5 miles to a boat-landing at the south end of Haslam Lake. From here a boat may be taken for 2 miles to the camp-cabin on the north-west shore of the lake.

The showings are scattered along the hillside between

elevations of 430 feet and 1150 feet above Haslam Lake.

The mineralization consists of small amounts of molybdenite in scattered occurrences of (1) aplite or fine-grained granite dykes, (2) quartz-filled joints ranging from 1/16 of an inch to 1 1/2 inches wide, and (3) quartz veins ranging from 4 to 18 inches wide. Assays of the samples taken ranged from: Molybdenite, nil to 0.2 per cent. The rock is quartz-diorite.

The main working is an adit 430 feet above the lake and approximately 1,600 feet westerly from the cabin. The working has been driven northerly as an open-cut 15 feet wide for 9 feet, then as an adit 10 feet high for 12 feet. This development cuts three aplite or fine-grained granite dykes in quartz-diorite. The dykes strike north 40 degrees east, dip 60 degrees north-westward and range from 4 to 18 inches wide. A small amount of molybdenite occurs as 1/8 to 1/4 of an inch flakes associated with pegmatitic quartz and feldspar on the footwall-side of the largest aplite dyke. Two selected samples of the best material assayed: Molybdenite, nil.

At a point 520 feet above the lake and about 900 feet south-easterly along the hillside from the adit, a stripping 15 feet wide extends in a direction north 15 degrees west for 45 feet. The bottom or southern part of the cut was covered by sloughed overburden at the time of the writer's examination (September, 1939). No mineralization was seen in the exposed part, but the dump showed a considerable amount of material consisting of quartz stringers from 1/2 an inch to 2 inches wide that contained molybdenite and chalcopyrite. Several of these stringers are reported to occur in the lower part of the stripping.

At a point 80 feet south-westerly along the hillside from the last stripping and approximately 500 feet above the lake, a second stripping extends in a direction north 15 degrees west for 35 feet. This stripping ranged in width from 10 to 15 feet. The mineralization consists of numerous quartz veinlets occupying joints in the quartz-diorite. These veinlets generally range from 1/16 of an inch to 1 1/2 inches in width; one 4-inch vein was seen. In the 35-foot length of stripping 65 veinlets were seen, spaced from 4 inches to 2 feet apart. They contain quartz and small amounts of molybdenite and chalcopyrite. Seven chip-samples taken over consecutive 5-foot sections along the stripping assayed from: Molybdenite, nil to 0.2 per cent.

At a point 100 feet south-westerly from the last strip-

ping, a quartz vein has been exposed for 25 feet. This vein is vertical, strikes north 50 degrees east, ranges in width from 2 to 6 inches, and contains a small amount of molybdenite and chalcopyrite.

Thirty feet above and due west from the adit, a little open-cutting has been done on a vertical shear that strikes north 45 degrees east. The shear is 1 foot wide and consists of sheared, chloritic quartz-diorite that contains a small amount of disseminated chalcopyrite and green carbonate. It contains neither quartz nor molybdenite.

At a point northerly from and 160 feet above the adit, a small cut 2 by 5 feet with a 10-foot face, has been made on an 8-inch wide aplite dyke that strikes north 50 degrees east and dips 75 degrees north-westward. The dyke contains only a very little molybdenite.

At a point northerly from and 350 feet above the adit, a cut 10 feet long by 2 feet wide by 2 feet deep has been made on a quartz vein from 6 to 12 inches wide that strikes north 50 degrees east and dips 75 degrees north-westward. The mineralization consists of a small amount of magnetite, molybdenite and yellow molybdic ochre.

Aplite, or fine-grained granite dykes cut the quartz-diorite at various places on the hillside between the adit and a bench approximately 700 feet above. These dykes, strike north-easterly, dip steeply north-westward, range in width from 12 to 18 inches, and in places contain a small amount of molybdenite in paper-thin seams.

JERVIS INLET - MT. WELLINGTON MOLYBDENITE PROSPECT. (38)

In 1937, the writer examined an occurrence of molybdenite on the south-easterly slopes of Mt. Wellington, a mountain opposite or south-westerly from the mouth of Princess Louisa Inlet, near the head of Jervis Inlet. The occurrence is half a mile south-west from the south-west end of a lake, about 2 miles long, that is approximately 3 miles from and 2,800 feet above tidewater. The writer examined this prospect in September, 1937.

Access is by Union Steamship up Jervis Inlet to Gustafson's Logging Camp, where a launch may be obtained; thence by launch for 10 miles to the mouth of a small creek that flows into Queen's Reach of Jervis Inlet from the south-west, at a point opposite the mouth of Princess Louisa Inlet. From the beach, access is by an old logging incline or skid-way that

extends up a very steep slope westerly to a point 2400 feet above the lake; thence by a poorly defined foot-trail south-westerly for approximately 2 miles to the north-east end of a small lake 2800 feet above tidewater. From this end of the lake a log raft is used to travel, for approximately 2 miles, to the other end of the lake. From here, a foot-trail leads south-westerly for half a mile to the bottom of a large talus slope that extends upwards to the base of unscalable rock bluffs.

There are no workings on the property. The molybdenite occurs in talus fragments as 1/8-inch flakes in clusters that range from 2 inches to 4 inches in diameter scattered in quartz-diorite, and as similar flakes associated with 2-inch clots of pegmatitic quartz, feldspar and mica, widely scattered in the quartz-diorite. The occurrence of the molybdenite is not controlled by any recognizable structure. Many of the talus-boulders contain numerous rust spots that are the result of oxidation of grains of pyrrhotite and pyrite.

Although two samples, taken across two individual clusters, assayed: Molybdenite, 2.6 per cent. and 2.7 per cent., respectively, these clusters are too widely spaced to permit mining in the aggregate; the distances between clusters range from 1 foot to several feet.

GRAY CREEK (49)

An occurrence of molybdenite on Gray Creek was examined by the writer in June 1938. This is an old discovery and is considered to be the same one described by Wilmot (1925, p. 31), which was staked between 1916 and 1919 by Axel, Chas. O. and Swan. A. Swanson. The underground work was probably done during that period.

The property is reached from Gray Creek post-office, on the east side of Kootenay Lake, by following a road easterly for 1 1/2 miles to Magee's farm, and then by following an old, overgrown road for three-quarters of a mile to the only accessible working, a long drift-adit.

The ground in the immediate vicinity of the adit is covered by dense bush and the hillside rises steeply above the adit in a north-easterly direction.

The adit has been driven north 62 degrees east for 57 feet, north 56 degrees east for 40 feet, north 62 degrees east for 67 feet, and north 48 degrees east for 11 feet to the face. Throughout its length it follows a vertical quartz vein that maintains a fairly uniform width of 3 feet. With the excep-

tion of a 4-foot aplite dyke, the rock is massive granite. The aplite dyke is vertical and strikes across the adit in a direction north 45 degrees east at a point 135 feet in from the portal.

The vein-matter consists of abundant quartz, scattered masses of pyrite, clusters of muscovite and a small amount of molybdenite. The location, width and assays of samples from those sections of the vein showing most molybdenite, are as follows. No. 1, 40 feet from the portal, across 3 feet of vein-matter containing a considerable amount of pyrite and some molybdenite: Gold, trace; silver, 0.2 ounces per ton; molybdenite, 0.04 per cent. No. 2, 75 feet from the portal across 3.5 feet of vein-matter containing some molybdenite but no pyrite: Gold, nil; silver, nil; molybdenite, 0.3 per cent.

LITTLE KEEN PROPERTY. (50)

The Sapples molybdenite property consists of the Little Keen, Lost Chance and Lucky Jim mineral claims staked in 1932 and owned by Jack Sapples of Salmo. The property was examined by the writer in June 1938.

This property is on the west side of Bennett (Bear) Creek close to its junction with Sheep Creek. The actual showings are 500' above the Sheep Creek road and about half a mile southerly from the road. The property may be reached by motor-road from Salmo by following the Salmo-Nelway highway for 4 1/4 miles southerly from Salmo, then turning to the east and following the Sheep Creek road for 3 3/4 miles to the camp at Bennett Creek.

The showings are on a steep hillside, part of which slopes north-easterly into Bennett Creek and partly to the north into Sheep Creek. The hillside was severely burned over several years ago and is now covered by down-timber and brush.

The general geology is described by Walker (1934, p. 86) in the following quotation:

> "Molybdenite occurs in, and close to the contact of, aplitic granite with sediments of the Pend-d'Oreille series. This is presumably the occurrence mentioned by O. E. LeRoy in the explanatory notes on the sketch map of Sheep Creek mining camp.
>
> "Several cuts and strippings expose a north-dipping contact between granite and strata of the Pend-d'Oreille

series. The granite is fine-grained and aplitic at the contact and locally is altered, the alteration being characterized by the development of greenish white talc with which molybdenite appears to be associated. The granite is very rich in quartz, about 30 per cent, and the feldspar is orthoclase or microcline with a relatively small amount of plagioclase. The argillaceous sediments at the contact are highly altered to a mass of pyroxene, amphibole, calcite, and titanite. The intensity of alteration rapidly diminishes away from the contact. The limestone band is in part intensely altered and holds abundant brown garnet and tremolite, considerable molybdenite, and a little pyrrhotite. The less altered limestone has been given a greenish colour.

"Disseminated molybdenite occurs in the sediments for a few inches away from the contact, and also along fractures for 1 foot or 2 feet from the contact. The most northerly cut exposes altered sediments, and limestone cut by granite tongues. Molybdenite occurs in a narrow, vertical fissure striking 40 degrees and also along joint planes in the limestone.

"It is evident that the molybdenite is closely associated with the granite contact and occurs either in the granite or the enclosing sediments for short distances on either side of the contact."

The workings, consisting of a short adit, open-cuts and strippings, are described below.

The position of the workings will be given in respect of the single short adit which is about 500 feet above the Sheep Creek road.

From a point 80 feet north-easterly down the hill on a 35-degree slope from the short adit, an open-cut, 8 feet wide, has been driven for 12 feet in a direction south 25 degrees west. The face exposes a granite-sediment contact that ranges in strike from south 20 degrees west to south 10 degrees east and dips 45 degrees westward; the granite lies under the sediments on the south-easterly side of the contact. Although the strike of the contact is locally very irregular, it can apparently be traced up the hillside to the south toward the adit and nearby workings. No molybdenite was seen in this working.

The adit (as of June 1938) begins as an open-cut driven in a direction south 25 degrees west for 10 feet to the portal;

from here the adit extends in the same direction for 5 feet to the face. The north wall of the working consists of granite and the south wall of sediments. Small amounts of molybdenite occur at the contact and in the granite for 3 feet from the contact. A sample along 2.8 feet of what appeared to be the best grade of material from the contact assayed: Molybdenite 1.5 per cent. Two samples of mineralized granite near the contact taken across 2.9 feet and 1.6 feet assayed respectively; Molybdenite 0.9 and 0.3 per cent. In this working the sediments contain very little molybdenite.

From a point 18 feet in a direction north 70 degrees west from the mouth of the last open-cut, a deep open-cut extends in a direction south 25 degrees west for 17 feet to a rock-face; this working seems to be the oldest on the property. The rock in this cut consists of phyllite and limy sediments that have been largely replaced by bands of the lime-silicate minerals diopside, brown garnet, and wollastonite. The sediments strike north 45 degrees west and dip 35 degrees north-eastward. In this cut molybdenite occurs in a 4-foot diopside-garnet band about 4 feet thick on the south-east wall at a point 12 feet back from the face. A sample taken across it assayed: Molybdenite 0.5 per cent. It is interesting to note that the sediments in the face of this working are cut by an 8-inch, aplite sill. This aplite is in part replaced by pegmatitic quartz and the latter by brown garnet.

From the mouth of the adit open-cut, a stripping extends south-easterly for 45 feet. This exposes only granite.

From the south-east end of this stripping a cross-trench extends south-westerly for 15 feet to a combined stripping and open-cut that extends 15 feet south-easterly and 25 feet north-westerly. This working exposes a contact between granite on the north-east and sediments on the south-west; the contact appears to strike north 70 degrees west and dip 40 degrees south-westward. Two lenses of molybdenite occur along this contact; No. 1, measures 6 feet by 6 inches and a sample across it assayed: Molybdenite 3.9 per cent.; No. 2, measures 2 feet by 18 inches and a sample across this assayed: Molybdenite 0.9 per cent. Towards the upper or south-easterly end a small amount of molybdenite was seen across a 2-foot width of sediments close to the contact; a sample taken across this assayed: Molybdenite 0.3 per cent.

The rock in this working consists of granite to the north-east of the contact and phyllite to the south-west. A small amount of diopside and garnet occurs along the contact.

Several open-cuts have been dug to the south up the hillside from the last cut. Although some of these expose a granite-sediment contact, none contain molybdenite other than in traces.

The showings as of June 1938, do not show any mineable bodies of commercial ore.

MOLLY (52). The Molly molybdenite property consists of the following Crown-granted claims: Molly and Molly Nos. 1 to 9 inclusive which are owned by the Consolidated Mining and Smelting Company of Canada, Ltd. This property was examined by the writer in June, 1938.

The property, located on Lost Creek in the Nelson Mining Division, is reached by leaving the Nelson-Nelway Highway at a point approximately 9 3/4 miles south of Salmo and following an old road that goes up the south fork of the Salmo River for approximately 1 1/2 miles to Lost Creek, thence by a branch road north-easterly up Lost Creek for 2 3/4 miles to the old camp-site that is half-a-mile to the west of the mouth of a northerly-flowing tributary of Lost Creek. At the time of the writer's visit (June, 1938), it was impossible to take a car more than 1 1/2 miles up the road.

The workings are on the south side of Lost Creek approximately 600 feet above the creek-bottom on a steep northerly-sloping hillside.

The general geology is as given in the following extract by J. F. Walker (1934, p. 85):

> "The property is on the west end of a large area of granite extending for 4 miles along Lost Creek. The edge of the granite body at the Molly runs a little east of south up the hill to an elevation of 4,000 feet, where it turns east and follows this direction for a little over 1,500 feet, to where it resumes its south course. To the west sediments* (argillaceous) outcrop for about 1,200 feet, beyond which granite outcrops westerly for several hundred feet, and up the hillside to elevations of 3,600 feet to 3,700 feet.
>
> "The granite is jointed or sheeted more or less parallel to the contact with the sediments. The molyb-

* (insertion by Stevenson)

denite occurs in the granite close to the contact and mostly in a sheeted zone having a maximum observed width of 10 feet. The sheeted zone strikes from 15 degrees to 25 degrees, and dips from 40 degrees westerly to vertical. The best mineralization appears to be at a point where the contact dips at low angles as if this point were near the top of the granite body. The northerly extension of the best mineralization appears to have been eroded away. A little molybdenite can be seen disseminated throughout the granite in the single, short adit.

"The most favourable ground appears to be along the contact (into the hill-side) south from and about at the level of the open-cuts. Some diamond drilling has been done in this direction, but the results are unknown to the writer.

"Four thin sections were cut from specimens taken across 3 feet of the sheeted zone holding average grade mineralization. One section holds only traces of molybdenite. In the other three sections pyrrhotite is the predominating sulphide and is accompanied by chalcopyrite, molybdenite, and pyrite. Almost all the molybdenite is intergrown with pyrrhotite in grains few of which are larger than 0.05 mm. and many are smaller. The mineralization appears to be later than the granite. Molybdenite is plastered along some of the joint planes in the sheeted zone, and forms a small percentage of the high-grade ore."

The workings, which consist of one short adit and several open-cuts, are described in detail below.

The adit has been driven in a direction south 45 degrees east for 58 feet to the face. At a point 50 feet from the portal a cross-working has been driven in a direction south 35 degrees west for approximately 45 feet. From a point 15 feet back from the face of this cross working, a raise connects with a deep open-cut approximately 80 feet above. Five feet north-easterly from the raise a working has been driven to the west for 5 feet where a large winze now filled with water and of unknown depth has been sunk. The only structure in the adit is a 4-foot section of sheeting in the south-west end of the cross-working; otherwise there is only massive granite. A few specks of molybdenite were seen in the walls of this adit. However, it is reported by Wilmot (1925, p. 37) that the best ore on the property was found at the bottom of this winze.

The raise from the adit breaks through into the floor of an open-cut 12 feet deep and 8 feet wide that extends easterly up the hillside on a 30-degree slope for approximately 80 feet. The whole cut is within the zone of well-defined sheeting in the granite. This zone has a minimum thickness of 8 feet in the cut. The component joint-planes strike north 25 degrees east and 45 degrees westerly. The joint-planes, spaced from 6 to 18 inches apart, are by no means parallel, they curve gradually into each other and enclose masses of unfractured granite. Neither the joint-planes nor the intervening granite in this cut carry much molybdenite.

Ten feet north-easterly from the top of the last cut, a small cut has been driven 4 feet in a direction north 75 degrees east and 4 feet in a direction north 25 degrees east. This cut is in the same sheeted zone. Two samples taken across the sheeting in this cut assayed: Molybdenite 0.1 and 0.08 per cent. respectively.

Several shallow cuts and strippings have been made for a distance of 60 feet north-easterly from here. These indicate that the zone of closely spaced sheeting dies out north-easterly and a few small patches of quartz-feldspar pegmatite appear.

A short distance to the south-east up the hillside from the open-cut immediately over the raise, a large open-cut has been excavated along the contour of the hillside for 75 feet in a direction north 30 degrees east. At the south-westerly end of this cut sheeting is well developed over a zone that measures 14 feet in thickness. The joints, 4 inches apart, are more closely-spaced than in the lower cut, and they strike northerly and dip 35 degrees westward. Although the sheeted zone contained more molybdenite than any other part of this cut, the amount was very small. A sample taken across its width assayed; Molybdenite 0.1 per cent. To the south-east up the hill from this cut, in the foot-wall of the sheeted-zone, as in the cuts north-easterly from the main cut, small patches of quartz-feldspar pegmatite were seen.

It is understood that a considerable amount of diamond-drilling was done by the Consolidated Mining and Smelting Company previous to 1934.

Although no ore was in sight at the time of the writer's examination, past reports indicate that a considerable tonnage of high-grade material was mined and shipped. Descriptions by Drysdale (1915, p. 254) and by Wilmot (1925, p. 37) indicate that the ore must have come from the main open-cut and raise connecting the adit with the open-cut and, from the winze in the adit. The following is the record of production, as given by Wilmot (1925, p. 38):

TABLE IV

Shipments from Molly Mine, B. C.

Date	Shipments	Place of Extraction	To Whom Sent	Pounds dry ore	Per cent. Molybdenite (MoS_2)	Remarks
1914	1	Surface showings	Henry E.Wood, ore testing plant, Denver, Colo.	17,119	9.335	Molybdenite (MoS_2) 85% of contents at 20¢ per pound.
	2	"	"	822	30.175	"
	3	"	"	29,895	10.250	"
1915	1	Top of shoot	"	48,202	12.26	90% of Molybdenite (MoS_2) contents at 50¢ per pound.
	2	Ore samples	New York	4,000	9.50	At schedule rates
1916	2	Underground	International Molybdenum Co.Renfrew	22,810	10.36	(hand-cobbed)
1917	4	"	"	181,000	3.84	At schedule rates
	1	"	Mines Br. ore testing plant, Ottawa	44,924	3.14	"
	2	"	.....	56,148	3.31	"
TOTALS				404,920	5.88	

The average recovery from run-of-mine ore seems, therefore, to have been about 3 1/2 per cent.

MARGARET GROUP (62)

The Margaret group consists of six mineral claims, the Margaret, Emily, William, David Fred and Jean, staked in 1936 and owned by O. A. Woolsey of 4329 Kinney Street, Vancouver. The writer examined this property in September, 1937.

The property is 12 miles north-westerly from the head of Pitt Lake. It is reached from Pitt Lake by following Pitt River up-stream for 3 miles along an old motor-road, then crossing the Pitt River to the west side in a rowboat; thence by good pack-horse trail for 9 miles to the camp and workings at an elevation of 1800 feet.

The showings are between elevations of 1650 feet and 1850 feet, on Boise Creek that flows south-easterly into Pitt River, joining it approximately 4 miles above the head of Pitt Lake. The most important showings are along the banks of Boise Creek near its junction with a small south-westerly flowing creek that joins Boise Creek from the east at an elevation of 1670 feet. Several less important showings occur along the bed of this branch creek and isolated showings in other more remote branch creeks.

In the immediate vicinity of the showings, Boise Creek flows in a V-shaped valley, the hillsides of which are heavily timbered. In many places sloughing along the creek banks exposes bed-rock and the molybdenite showings. The main branch-creek flows through a rocky canyon and over a rocky floor to Boise Creek.

The rock formation of the immediate area is quartz-diorite that includes many large and small inclusions of fine diorite, andesitic greenstone and remnants of feldspar-porphyry dykes.

In the vicinity of the main molybdenite showings, the hybrid mixture of quartz-diorite and diorite is conspicuously sheeted by closely-spaced joints; however, these do not appear to have influenced the localization of the molybdenite. On the other hand, it is to be noted that the most abundant molybdenite occurs in an area where the amount of diorite conspicuously exceeds the quartz-diorite, whereas quartz-diorite with very little diorite, common at distances of 500 feet or more from the main molybdenite occurrences, contains only widely scattered flakes of molybdenite.

The molybdenite occurrences on the property are of two types. First and most important, are stringers and clusters of molybdenite flakes in silicified crush-zones that are up to

3 feet wide; and second, scattered segregations in clean-cut quartz-pyrite veins that range from 1/2 an inch to 12 inches wide. Of these two types, the first is the more important.

The main occurrence of molybdenite is at the portal of the only adit which has been driven on the south-west side of Boise Creek, opposite the junction of this creek, at 1670 feet elevation, with the branch-creek as above described.

This adit has been driven in a direction south 25 degrees east for 25 feet. Most of the molybdenite occurs in an indefinite zone that ranges from 2 to 3 feet wide, and strikes north-easterly. This zone consists of leached and silicified wall-rock that contains scattered clusters of flake-molybdenite and quartz-pyrite molybdenite veinlets which range from 1 inch to 3 inches wide.

Three samples taken across this zone assayed as follows. Across 12 inches at a place 6 feet in from the portal; Molybdenite, 0.72 per cent; iron, 8.5 per cent. Across 28 inches at the portal: Molybdenite 0.36 per cent.; iron, 4.6 per cent. Across 14 inches at a point 3 feet out from the portal: Molybdenite, 1.26 per cent.; iron, 5.7 per cent.

Immediately to the north and north-east across Boise Creek from the adit, two small cuts have been dug on two lean molybdenite showings. One cut, is located 75 feet in a direction north 45 degrees east from the adit, and has been driven 3 feet north-easterly; the other cut 8 feet above, is 30 feet north-westerly up-stream from the lower, and has been driven 8 feet in a direction north 20 degrees east.

The lower cut exposes three irregular, gash veins of quartz and pyrite, averaging 2 inches wide, that occur in a 5-foot wide leached zone in the quartz-diorite; this zone contains a small amount of disseminated molybdenite. The upper cut exposes a flat vein, 4 inches wide, containing quartz, pyrite and a small amount of molybdenite.

A small cut has been driven 3 feet north-westerly into the bank of a small branch creek, at a place 150 feet in a direction north 70 degrees west up-stream from the last upper cut. This cut has been driven on a lenticular crush-zone that ranges from 4 to 8 feet wide and contains four 4-inch veins of quartz, pyrite and a little molybdenite.

Several widely spaced quartz-molybdenite veins occur in the bed of the branch creek that joins Boise Creek directly across from the adit. These will be described consecutively

up-stream towards the falls.

Number 1 is a 4-inch wide quartz-molybdenite vein-outcropping in the east bank 50 feet above the creek bed, 230 feet up-stream from Boise Creek. A sample taken across this assayed: Molybdenite, 0.9 per cent.; and iron, 5.0 per cent.

Number 2, a 4-inch wide quartz-pyrite vein in the bed of the creek and 240 feet up-stream from Boise Creek, contains only a little molybdenite.

Number 3, 40 feet up-stream from number (2) is a 12-inch wide quartz vein that contains the most abundant molybdenite of any of the occurrences on the property. A 12-inch sample across this assayed: Molybdenite, 2.52 per cent.; and iron, 1.9 per cent.

Number 4, 70 feet up-stream from number (3) is an 8-inch wide quartz-pyrite vein with very little molybdenite.

Number 5, 30 feet up-stream from 4, is a 3-inch wide quartz-pyrite vein.

Number 6, 70 feet up-stream from number (5), is a zone containing six, 4-inch wide veins of quartz and heavy pyrite, but containing only a little molybdenite. A 10-inch sample of this assayed: Molybdenite, nil; and iron, 9.4 per cent.

In the rock bluffs immediately below the falls of a creek that flows south-easterly into Boise Creek 1500 feet up-stream from the adit, there are a few quartz-pyrite-molybdenite stringers in the massive diorite.

Four hundred feet down Boise Creek from the adit, an 8-foot cut has been driven north-easterly into the east bank of the creek on a 10-inch wide fracture zone that contains pyrite, quartz, broken diorite and a little scattered molybdenite.

At an elevation of 1840 feet on both banks of a creek, that flows north-easterly into Boise Creek and joins it approximately 1000 feet down-stream from the adit, there is a wide crushed and leached zone in the quartz-diorite that carries scattered and varying amounts of molybdenite. Here, a combination of open-cutting and sloughing of the stream-banks has exposed two main crush-zones, one down-stream, 12 inches wide and one up-stream, 12 feet wide; the strike of both zones is indefinite, but is apparently south-easterly across the creek. A sample taken across the 12-inch wide zone assayed: Molybdenite, 0.72 per cent; iron, 5.4 per cent. A 6-foot sample

Fig. 4. Tidewater molybdenum property.
Plan showing surface geology.

taken across the best mineralization in the 12-foot zone assayed: Molybdenite, nil; iron, 2.9 per cent. The rock in these crush-zones is both silicified and sericitized to such an extent that the original nature of the rock is destroyed; however, it is considered to be quartz-diorite and similar to that up-stream and down-stream. For a short distance down-stream from these crush-zones there are numerous tight, widely-spaced stringers of quartz and pyrite and a little molybdenite, from 1 inch to 2 inches wide.

At an elevation of 3400 feet in a small creek that flows north-easterly into Boise Creek and disappears in a rock and snow-slide 300 feet up-stream from the adit, occasional stringers of quartz and molybdenite are exposed in the quartz-diorite bed-rock of the stream.

TIDEWATER MOLYBDENUM PROPERTY* (74)

This property comprises the Molybdenum and Success Crown-granted claims and several claims held by location. It is owned by G. W. Bruggy and associates of Alice Arm, who purchased the two Crown-granted claims at Tax Sale in 1930.

Lots 3618 3655 ± Cassiar

The claims are on the north side and at the head of the Alice Arm inlet, about 4 miles from the town of Alice Arm. The camp and main workings are at about 1,000 feet elevation and about 1 mile from the beach.

The area is reached by coastal steamer to Alice Arm and thence by launch to the property, camp and workings. A good pack-horse trail extends from the beach.

The property is on the lower southern slopes of the Chaloner Range of the Coast Mountains. From the beach to the camp and adits, the hillside has a general slope of about 15 degrees, with intervening knolls and ridges, and is covered by fallen and some standing burnt timber and by characteristic underbrush. From the camp to the northern extremity of the surface showings, at 1,370 feet elevation, the hillside has a general slope of 25 degrees. North of this elevation, and towards and in the area of granitic rocks, the slope steepens and the hillside becomes more rugged. Green timber composed mainly of hemlock, with some spruce and cedar, extends up the hillside to timberline at about 3,500 feet elevation.

The old mill buildings, tramway and bunkers have completely collapsed, but one cabin, at an elevation of 1,005 feet and two

*A synopsis of a report by Joseph T. Mandy.

blacksmith-shops still stand and are in good condition.

The cabin is equipped to accommodate three men and the blacksmith-shops are equipped for hand-steel work. There is no machinery on the ground.

The volume of water in the creek would be probably sufficient for camp use, although during dry periods the volume would be greatly reduced.

There is sufficient timber in the locality of the workings for mining requirements and there is abundant firewood close at hand.

The deposit consists of numerous disconnected lenses of quartz mineralized with varying amounts of molybdenite.

The rocks in the area include sediments and some greenish andesitic dykes of the lower Hazelton group of Mesozoic age, intruded by granitic rocks of the Coast Range batholith. The main eastern contact of the batholith lies 1 mile to the west of the property.

The sedimentary rocks consist of interbedded slates, argillites, argillaceous sandstone, sandstone and quartzite and possibly some beds of water-lain tuff. The rocks have a general north-easterly to easterly trend and although folded with varying degrees of intensity, they have a comparatively steep southward dip. These rocks are intruded by numerous hard and fine-grained, greenish andesitic dykes of pre-batholith age.

All the above rocks are intruded by spurs and dykes related to the batholith. In the vicinity of the showings, these spurs consist of bodies of aplite and rhyolite, some granitic dykes and numerous lamprophyre dykes which strike in a general north-easterly direction and dip steeply westward. These rocks and their structural relations are especially well-exposed along the beach and in the creek-canyon.

Aplite and rhyolite occur to the north and west of the molybdenite-bearing quartz veins and appear to limit the continuity of the veins. On the surface, Fig. (4), the veins strike north-easterly towards a body of pink aplite which trends easterly. As the aplite is approached the feldspar content of the veins increases and the veins merge with the aplite. In the underground workings an appreciable feldspar content is evident in places in the veins in their most northerly exposures.

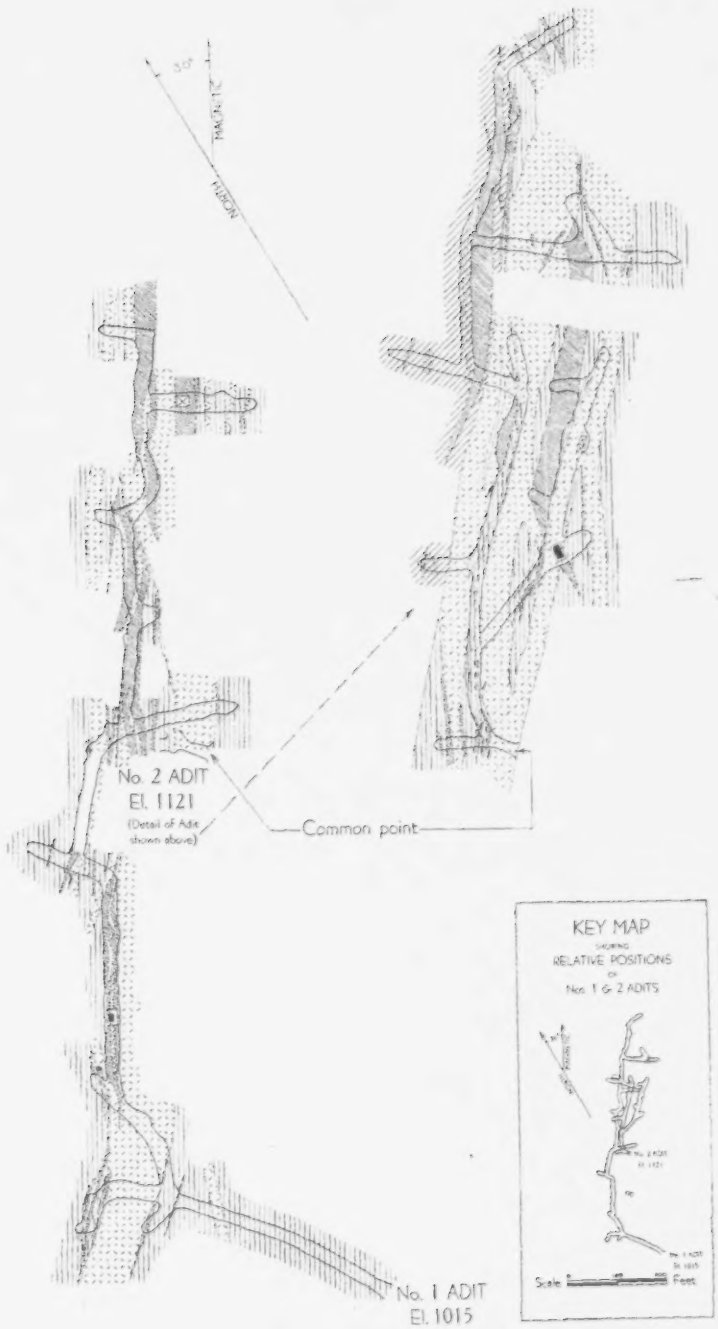


Fig. 5. Tidewater molybdenum property. Plan showing underground geology.

A body of rhyolitic rock Fig. (5), converges towards the veins from the west and disrupts their continuity, both on surface and in the northern section of No. 2 adit drift. Locally the aplite at the northern end of the showings contains patches and streaks of disseminated molybdenite. The evidence suggests that the veins and molybdenite mineralization originated from the batholith at a late stage in its consolidation. The veins could be classified as pegmatitic quartz veins.

Shearing is prevalent along lines striking between north and north-easterly and dipping steeply westward, generally following the contacts of the dykes with the sedimentary rocks. Locally, the shearing cuts the veins and the lamprophyre dykes. Some faulting has occurred, but no appreciable displacements of the formation or the veins is evident. Lamprophyre dykes cut the veins, and interrupt their continuity so that projection of the veins along their strike and dip is difficult.

The veins are exposed in the workings, Fig. (5), and intermittent outcrops, Fig. (4), between 1,015 and 1,344 feet elevation, along a horizontal distance of 920 feet. They outcrop in a creek-canyon, in both the bed of the creek and on the canyon-walls, Fig. (4). These veins comprise quartz stringers, veins and lenses, ranging from a fraction of an inch to several feet wide, mineralized with fine-grained molybdenite. The molybdenite is erratically distributed within the veins as thin ribbons and to a small extent as disseminated material within the vein-quartz. As the quartz generally breaks along the ribbon-banding, freshly broken vein-matter can give a most deceiving appearance of solid molybdenite mineralization, whereas this mineral occurs only as a thin coating on the walls of the fractured quartz. Locally, a mere shadowy banding of the quartz is the only evidence of mineralization, and, when such material is broken, finely-divided molybdenite is visible under a magnifying glass. The only sulphide accompanying the molybdenite in the lower exposures and main workings is a small amount of pyrite. The molybdenite mineralization is confined to the quartz veins and does not penetrate the wall-rocks.

As the veins approach and merge with the aplite to the north, the tendency to disperse increases, the stringers become smaller and tighter, the pyrite content increases and galena, sphalerite, arsenopyrite and some chalcopyrite begin to occur. In the aplite, some shearing similar in strike to that of the quartz veins is locally well-mineralized with galena, sphalerite, arsenopyrite, some chalcopyrite and tetrahedrite. In former years, some work was done on these showings, but the workings have sloughed and are now covered with

talus. The aplite, into which the molybdenite-bearing quartz veins appear to merge, locally contains some streaks and patches of molybdenite.

The quartz veins, stringers and lenses strike in a general north-easterly direction and dip steeply north-westward. Local variations in strike and dip are frequent. The vein walls commonly vary in dip. These features tend to produce variations in width within short distances and great irregularity in horizontal and vertical continuity. Additional disruptions of continuity are caused by lamprophyre dykes cutting the veins. These dykes constitute a large proportion of the rock in the locality of the veins and frequently form both walls or completely encompass the quartz masses. Where the veins enter large areas of argillaceous rocks, they tend to form small stringers and to disperse. This is evident both underground and on the surface, especially in the most southerly outcrops south of the portal of No. 2 adit and in the most southerly exposures in No. 1 adit. Horizontal continuity of the veins is also disrupted as they approach aplite and rhyolite areas, the main masses of which lie to the west and north. Small tongues of these rocks, however, also project into the central section of the showings. The intrusion of these tongues is probably responsible for some of the blind or isolated masses of quartz occurring in the workings.

On the surface, the quartz becomes more glassy and the occurrence of feldspar more frequent as the veins approach the rhyolite and aplite. Underground, the same characteristics prevail to the north along No. 1 and No. 2 adits with a marked decrease in the molybdenite content of the quartz veins especially evident in No. 1 adit. In this section of the workings, quartzites become more abundant and are very common in the most northerly exposures of both adits. The evidence indicates the close approach of the most northerly underground workings of both No. 1 and No. 2 adits to intrusive rocks and the consequent disruption of the continuity of the veins in this direction at this general elevation.

A summary of the geological sequence of events is construed to have been as follows:

1. Deposition of sedimentary rocks.
2. Intrusion of green dykes.
3. Intrusion of granitic rocks.
4. Fracturing.
5. Formation of quartz.
6. Crushing and formation of ribbon-structure within the veins.

7. Deposition of molybdenite.
8. Intrusion of lamprophyre dykes.
9. Late shearing.

Details of the surface geology are shown in Fig. (4).

The property is referred to in The Annual Report, Minister of Mines, British Columbia, for the years 1916-1918 inclusive and 1928-1931, inclusive, and in G.S.C. Reports by McConnell, (1913, p. 93), Dolmage, (1922, p. 30-A) Wilmot, (1925, pp. 44-46) and Hanson, (1935 pp. 37-38). For references see bibliography at the end of bulletin.

In 1916 the mine was operated by the Molybdenum Mining and Reduction Company, (C.P. Riel, Manager). This company built a 100-ton flotation plant at the beach, and made connections with the workings by an aerial tramway. A description of the equipment and mill is given by J. M. Turnbull, in the Annual Report, Minister of Mines, British Columbia, 1916, pp. K-66-67.

It appears, however, that very little ore was treated in this plant because Wilmot, (1925, p. 45), says:

> "Of the 383 tons of ore that were shipped, all except 5 tons was sent to the International Molybdenum Company's concentrator at Renfrew. Owing to the average grade of the ore being 1.60 per cent MoS_2 instead of 3 per cent. as was expected, and to its complex nature, the Renfrew company were unable to make a concentrate and refused to accept most of the shipments. About 45 tons of the tailings, which appeared to be almost as rich as the original ore, was sent to Ottawa and reconcentrated, as a result of which 1,368 pounds of molybdenite was recovered.
>
> "The Department of Mines was approached with a view to treating the remaining ore at Renfrew, but the molybdenite market had then collapsed and the ore was not shipped."

The output from this operation came from the small stope to surface off the east drift of No. 2 adit.

From the time of cessation of these operations in 1916, the property remained idle until April 1930, when work was resumed by the Dalhousie Mining Company, Limited, (D. S. Tait, Secretary). This work consisted of driving the No. 1 adit, and drifting in No. 2 adit. Work stopped on April 23rd, 1931.

In 1931 the Dalhousie Mining Company shipped a sample of 2700 pounds to the Canada Department of Mines' Ore Dressing and Metallurgical Laboratories, Ottawa. A detailed description of the metallurgical tests on this ore may be found in the Department's Report No. 393.

Very little surface work has been done, or if it had been done in former years the openings have now sloughed or are covered with talus. Surface continuity of the veins is established entirely by intermittent outcrops along the bed and banks of the creek, Fig. (4).

Underground development, Fig. (5), has been carried out in two main adits at respectively 1,015 and 1,121 feet elevation. No through-raises connect No. 1 and 2 adits. One raise has been started at the northerly end of No. 1 adit and extends for 59 feet. The small stope off No. 2 adit extends to the surface. Two shallow winzes have been sunk from No. 1 and No. 2 adits; these were full of water in October, 1939.

The details of the assay results and the sample locations, are illustrated on Fig. (6).

The method of cutting channel samples across the veins by hand moils was used throughout the examination. Whenever possible, these channels were evenly spaced at intervals of 5 or 10 feet, occasionally closer, to meet the mineralized characteristics of specific stretches of vein. In sections where stringers occurred, the stringers or veins were sampled either exclusive or inclusive of the intervening rock with the idea of obtaining the greatest degree of accuracy. In sections where certain widths of stringers were selectively sampled, the assay value is calculated across a total practical mining width with the intervening width of rock included in the calculation as containing no molybdenite.

Because of the markedly lenticular nature and discontinuity of the lenses within short distances, both vertically and horizontally, anyone making tonnage estimates from the assays as shown in Fig. (6), must make the calculations with due regard for such uncertainty in the projection of vein lengths and widths.

The best grade molybdenite mineralization noted on the property occurs in the old stope off No. 2 adit (upper). In this working sampling indicates a grade of 2.65 per cent. molybdenite for a length of 12 feet, and a width of 4.1 feet, but the tonnage of this material is small and limited.

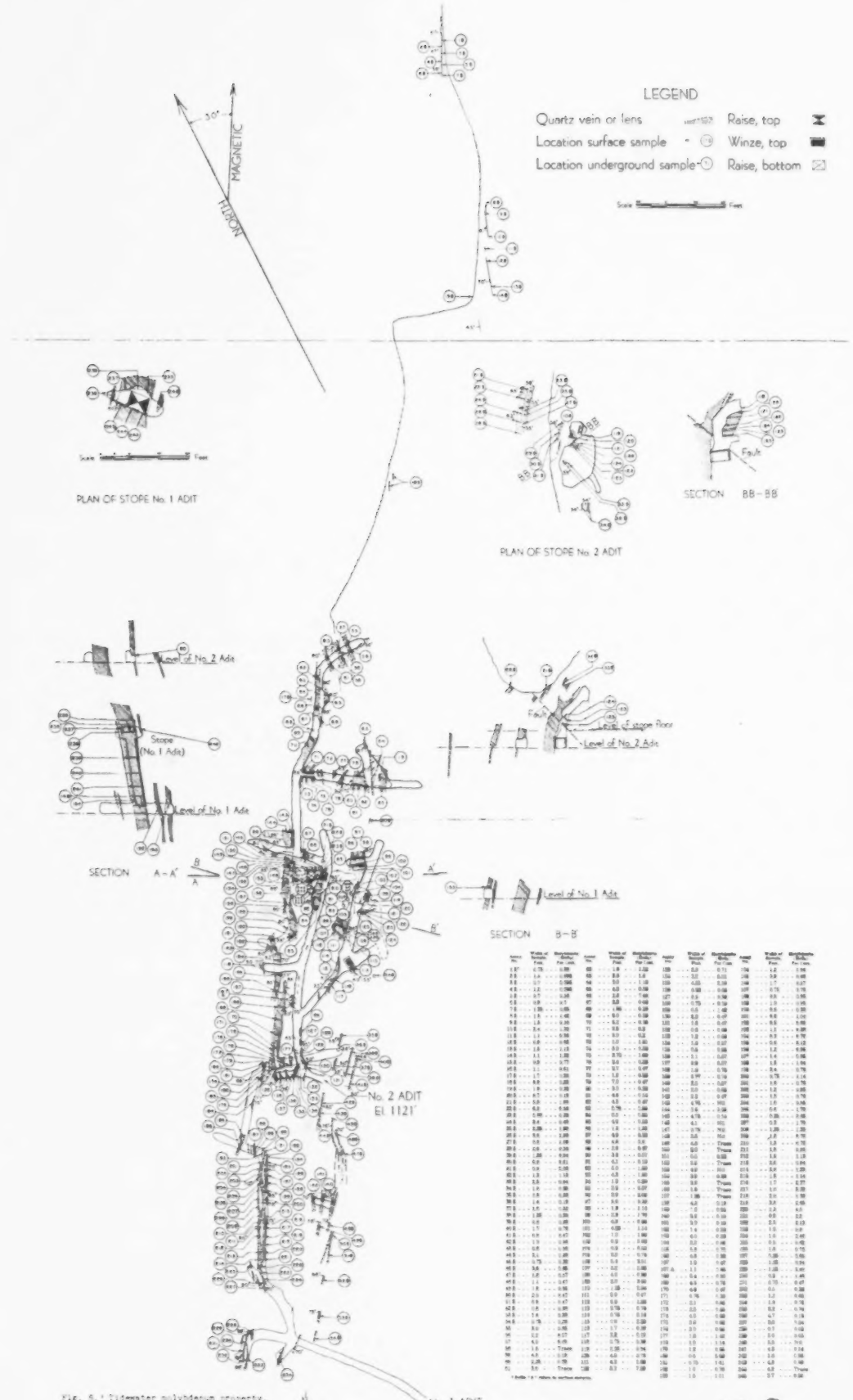


Fig. 5. Tidewater molybdenum property. Assay plan.

#9 (1)

In No. 1 adit, the best grade indicated is 1.05 per cent. molybdenite for a length of 78 feet and a width of 3.9 feet.

The mode of occurrence, type of deposit and geological structure relative to the mineral occurrence, indicates the probable limitation of continuity of the mineralization to the north by mergence with intrusive aplite, and to the south by stringering of the quartz in the sedimentary rocks. In depth, approach to intrusive rock is also indicated and although good widths of quartz occur, there is definite indication of diminution in grade.

Should further exploration be done on this property, it is recommended that this be confined to surface trenching towards the south from the present known southern limits of the veins with open-cutting of any vein exposures as warranted. Some exploratory drifting south in No. 1 adit on known structures, would also be constructive.

L-H GROUP (80)

The L.H. group comprises the mineral claims, L.H., L.H. No. 1, and L.H. No. 2, staked in 1938 by W. W. Lynes, Sicamous, B. C. and O. Hoglund, and owned by the same men. The writer examined this property in August, 1939.

The property is approximately 3 miles north-west of Malakwa, a station and small settlement on the Canadian Pacific Railway and on the Trans-Canada Highway, approximately 36 miles west of Revelstoke. From Malakwa station, the property is reached by a motor-road that follows the west side of Eagle River northerly for a distance of 2.2 miles, as measured from the station. From this point a fairly steep trail is followed for 8000 feet to the camp-cabin at an elevation of 2720 feet; this is a good pack-trail for approximately one-third of the distance from the end of the motor-road.

The workings are in the bed of a creek. The hillside on either side of the creek is steep, heavily wooded and covered with extensive overburden.

Most of the molybdenite occurs (1) in a shear-zone approximately 4 feet wide that strikes north and dips 25 degrees westward within pink granite, and (2) in widely-spaced shears that occur in the granite in the hanging-wall of the main shear-zone. The molybdenite occurs as paper-thin films in the curving slips associated with the shears and occasionally as scattered grains in the more massive granite between the shears. Samples taken across the shear-zone and elsewhere in the granite where molybdenite occurs, indicate that, although the

molybdenite as a mineral is conspicuous, the actual molybdenite content is low; the highest assay obtained was: Molybdenite 0.4 per cent.

The rocks on the property include pink granite, granite-gneiss, quartz-mica schist and a few lamprophyre dykes.

The pink granite appears to be a belt approximately 100 feet wide that strikes north and is bounded on the east by granite-gneiss and on the west by quartz-biotite schist and granite-gneiss.

The granite is medium in grain and light pink in colour. It is cut by the molybdenite-bearing shear-zone and by numerous shear-planes, spaced 1 inch to 4 inches apart, which strike north and dip 45 degrees westward.

A widespread development of sericite is indicated by the large amount of compact sericite within the shears, and by the complete sericitization of the feldspars in the granite. In addition to the molybdenite, a few stringers of quartz and scattered grains of pyrite occur within the granite.

The granite-gneiss is a grey, coarse-grained rock, consisting mostly of potash feldspar, quartz and biotite. It is distinctly gneissic and some phases possess a marked augen texture, characterized by the wrapping of large biotite flakes around lens-shaped fragments of feldspar. The foliation of the gneiss is vertical and strikes north 22 degrees east. The gneiss extends for an unknown distance both westerly up-stream and easterly down-stream from the pink granite, and appears to be the most abundant rock in the region.

Quartz-mica schist and interbedded massive quartzite extend up-stream for approximately 150 feet from the west side of the pink granite. The schist strikes fairly uniformly to the north-east, but the dip is variable, ranging from nearly horizontal to 25 degrees south-eastward.

Close to the granite the schist is cut by a 15-foot wide biotite-lamprophyre dyke that is approximately vertical and strikes to the north. A short distance farther up-stream, quartzite is cut by a similar dyke that is here only 4 feet wide, and strikes easterly and dips 20 degrees southward. A third lamprophyre dyke, 4 feet thick, strikes north-easterly across the creek from near the portal of the adit; this dyke dips 20 degrees north-westward.

The workings consist of a short adit on the south-west

side of the creek and shallow open-cuts on the north-east side.

The adit has been driven in a direction south 75 degrees west for 20 feet. The first 5 feet of the adit cuts the mineralized shear-zone which strikes northerly and dips 20 degrees westward; the remaining 15 feet of the adit passes out of the shear and the face is in relatively massive granite. The shear-zone is in the granite and adjacent to the hanging-wall-side of a 4-foot lamprophyre dyke that strikes north-easterly across the creek and dips 20 degrees north-westward. On the south-west side of the creek the dyke is wholly in pink granite, but on the north-east side it is wholly in granite-gneiss. It is to be noted that the contact between the pink granite and granite-gneiss strikes northerly across the creek from a point just east of the dyke at the portal of the adit.

The following samples were taken: No. 1, 4.5 feet vertically across the shear at the portal assayed: Molybdenite, nil. No. 2, 4 feet vertically across the shear 4 feet in from the portal on the north side of the adit assayed: Molybdenite, nil. No. 3, 4 feet similar to the last, but on the south side of the adit assayed: Molybdenite, nil. No. 4, across 6 inches of crushed matter at the face assayed: Molybdenite, 0.2 per cent. No. 5, black gouge from a slip at the face assayed: Molybdenite, 0.2 per cent. No. 6, 4.8 feet vertically in the face assayed: Molybdenite, 0.4 per cent.

The banks of the creek have been stripped clean for a distance of approximately 60 feet up-stream from the adit. On the south-west bank the shear-zone is exposed for approximately 20 feet northerly from the adit. A sample taken across it assayed: Molybdenite, nil. The main shear-zone, as exposed in the portal of the adit and for a short distance up-stream, does not continue as a definite zone across the creek; it seems to have been dissipated as a number of narrow, closely-spaced shears 2 inches or less wide. A small open-cut has been made on the most prominent of these at a point 40 feet northerly from the adit. However, samples across these mineralized shears assayed: Molybdenite, nil. Up-stream from the open-cut the granite is cut by many shears, some of which contain films of molybdenite. Several samples were taken, but only one assayed anything in molybdenite. This sample, taken across a shear at a point 30 feet up-stream from the open-cut assayed: Molybdenite, 0.3 per cent.

Inasmuch as the molybdenite is confined to the pink granite and more locally to shear-planes within this granite, further prospecting should be confined to areas along the con-

tinuation of this belt, either south-westerly diagonally down the hillside, or north-easterly diagonally up the hillside. Inasmuch as the slopes are covered by abundant overburden, the creek beds should be examined where they cut the projected extension of this belt.

STERLING (81) This property comprises the following mineral claims: Sterling Nos. 1 to 6, inclusive, White Rock Nos. 1 and 2 and White Pine Nos. 1 to 3. These claims were staked in 1938 and 1939 and are owned by August Smith, A. D. Coueffin, J. L. Mason and Harry Sawyer, all of Revelstoke, B. C. The writer examined this property in August, 1939.

The property is 34 miles north of Revelstoke on the Big Bend Highway. The camp-cabin is on the east side of the highway at a point 700 feet southerly from the 34-mile Post. The workings, east of and approximately 100 feet above the road, consist of three short adits, open-cuts and strippings.

The hillside slopes gently upwards east of the road and is covered by large timber and thick underbrush, so that prospecting, except in the creek-beds, is difficult.

The deposit consists of molybdenite, pyrrhotite and pyrite disseminated in bodies of massive, siliceous rock that are enclosed in quartz-muscovite schist and phyllite. The siliceous rock consists of abundant orthoclase and albite, and, lesser amounts of quartz and disseminated sulphides. It undoubtedly represents the high-temperature replacement of the schist and, or phyllite, by feldspar and quartz. Remnants of what appear to be muscovite schist in the siliceous bodies, suggest that quartz-muscovite schist was the rock replaced.

The largest replacement body, as exposed in No. 3 adit, has a width of 40 feet; its length could not be determined. The second largest, as exposed in No. 2 adit, has an exposed width of approximately 35 feet and may be the same body as that exposed in No. 3 adit. A thinner replacement body occurs approximately three-quarters of a mile northerly from those described above. This body ranges in width from 1 foot to 2 feet, and has a probable length of 175 feet.

In all these bodies the sulphide content is small. Although the pyrrhotite is fairly evenly scattered, the molybdenite is of erratic distribution. Assays of the best mineralization range, in all the bodies, from: Molybdenite, nil to a maximum of 0.6 per cent.

The bodies of high-temperature replacement will be referred to in the following descriptions as silicified material, or as silicified zones. It is to be noted that the term, silicified zone, refers in this instance to silicification by quartz, orthoclase and albite, and not, as is more usual, to silicification by quartz alone.

From a point that is 300 feet east of the cabin, the "No. 1" adit is driven north 32 degrees east for 12 feet, then north 22 degrees east for 36 feet, then north 32 degrees east for 90 feet to the face. From the face, a raise has been driven easterly on an angle of 30 degrees for 14 feet, then vertically for 11 feet to the top.

The only mineralization in this adit consists of disseminated pyrrhotite in the silicified rock near the portal; molybdenite and other sulphides are absent.

Commencing at the portal, the adit passes through 48 feet of completely silicified sediments, and then through 90 feet of black, lustrous phyllite to the face. Near the face the phyllite strikes north 55 degrees west and dips 25 degrees north-eastward and at 60 feet from the portal it strikes about north and dips 25 degrees eastward. The silicified sediments near the portal strike north 25 degrees east and dip 25 degrees south-eastward. At 46 feet from the portal a strong fault, strike north 35 degrees west, dip 42 degrees north-eastward, containing 8 to 12 inches of gouge, has been cut by the adit.

From a point that is 60 feet in a direction north 84 degrees east from the portal of the "No. 1" adit, an open-cut extends for 34 feet easterly to the portal of "No. 2" adit that is driven north 76 degrees east for 30 feet to the face. Commencing at its mouth, the open-cut passes through 18 feet of overburden, then through 16 feet of massive, siliceous rock. This rock extends into the adit for 18 feet from the portal; from thence to the face, the adit passes through silvery, quartz-muscovite schist that strikes north-easterly and dips 25 degrees north-westward. At 18 feet, 22 feet and 24 feet from the mouth of the open-cut, and from 10 feet to 20 feet from the portal, in the adit, and, at the face, short discontinuous lenses of quartz, parallel with the walls of the workings, have been exposed. These lenses, ranging from a few inches to 18 inches in thickness and from 1 foot to 8 feet in length, contain small amounts of molybdenite, pyrite, galena and sphalerite. Samples taken across the lenses showing the best mineralization assayed from: Molybdenite, nil to 0.6 per cent.

Stripping on the north-west bank of the creek, at a point 50 feet north-easterly up-stream from the mouth of the open-cut, exposes a small 4-inch patch of galena, pyrite and quartz in a larger area of massive, siliceous rock.

"No. 3" adit is driven from the south-east bank of the same creek that flows south-westerly past the mouth of "No. 2" adit. The portal of No. 3 adit is 255 feet in a direction north 21 degrees east from No. 2, and is driven north 30 degrees east for 70 feet to the face. At 52 feet from the portal a branch-working is driven south 86 degrees west for 22 feet.

Commencing at the portal, the No. 3 adit passes through carbonaceous phyllite for 28 feet, then to the face, through partly silicified quartz-muscovite schist that strikes north-easterly and dips 40 degrees north-westward. At 50-, 58- and 66 feet from the portal, the main-adit cuts lenses of quartz and at 5- and 18 feet from this working the branch-working cuts similar lenses. These lenses range from 1 inch to 14 inches in thickness and from 6 inches to 4 feet in length. Other than quartz, they contain only a little pyrite; no molybdenite was seen. Apart from the quartz lenses, the only other mineralization in this adit consists of pyrrhotite, pyrite and small amounts of molybdenite disseminated through the siliceous replacement-rock. Two checkerboard samples taken across the face of the side-working assayed: Molybdenite, 0.4 per cent. and 0.3 per cent., respectively.

Seventy-five feet north-easterly up-stream from the third adit, stripping along the south-east side of the creek exposes a flat-lying lens of quartz 14 inches thick by 3 feet long, which contains pyrite and some molybdenite. A sample taken across the lens assayed: Molybdenite, 0.4 per cent.

Showings of molybdenite outcrop approximately 500 feet up-stream from the highway-crossing in the bed of a small creek, locally known as Galena Creek, that crosses the highway 0.6 miles northerly from the cabin.

The workings on these showings consist of combined open-cuts and strippings.

From a point 20 feet south of the creek-bed, an open-cut is driven 5 feet easterly to a 4-foot face. This working cuts an irregular lens of barren quartz at the face and on the walls, which dies out within an exposed length of 8 feet. The lens cuts silvery, quartz-sericite schist that strikes north 35 degrees west and dips 40 degrees south-westward. A zone of

massive, silicified rock of irregular width extends from the north side of this cut north-easterly across the creek. This zone ranges from 1 foot to 2 feet in thickness, strikes northwest and dips south-westward with the enclosing schists. The silicified rock consists of abundant orthoclase and albite, lesser amounts of quartz, and scattered pyrrhotite and molybdenite. Three samples taken of the best mineralization assayed: Molybdenite, nil and 0.5 per cent.

The silicified rock is cut by two barren quartz lenses; by one in the open-cut first described, and by another at 40 feet north-easterly from the cut.

No. 2 working, 40 feet in a direction north 25 degrees east from No. 1, is an irregularly blasted area that extends 4 feet easterly and 12 feet northerly. It exposes molybdenite and pyrrhotite in the north-eastern extension of the silicified rock. A sample taken across 1 foot of the best mineralization assayed: Molybdenite, 0.5 per cent.

No. 3 working, 35 feet northerly from No. 2, is a combined stripping and open-cut that extends 10 feet along the strike, and 4 feet down and 2 feet across the dip of the silicified rock and enclosing schist; the schist strikes north 25 degrees west and dips 45 degrees south-westward. This exposure is probably the northern extension of the silicified rock exposed in and between No. 1 and No. 2 workings. Scattered molybdenite occurs in this exposure and a sample taken across the 2-foot thickness of the zone assayed: Molybdenite, 0.2 per cent.

Three trenches have been dug to the north of No. 3 working, but none of them expose any molybdenite. The farthest trench, 100 feet northerly from No. 3, exposes 1 foot of the silicified rock, which contains only a little pyrrhotite.

As measured between this working and No. 1, the zone of silicified rock appears to have a strike length of approximately 175 feet and a thickness ranging from 1 to 2 feet.

ALLIES MOLYBDENITE PROPERTY (91)

The Allies molybdenite property comprises the following mineral claims: Britain, France, Victoria, Belgium, Sunset and Panorama. The owners are Archie Cowie, 355 Nicol Street, Nanaimo, and associates of the same city. The writer examined this property in July, 1939.

The property is reached by (1) motor road for 15 miles from Nanaimo up the main south fork of the Nanaimo River to

the Nanaimo City waterworks dam, at an elevation of 820 feet, thence by (2) approximately 16 miles of trail up Jump Creek to the Jump Creek-Green River divide, and finally by trail up a steep hillside to the camp-cabin at an elevation of approximately 3,200 feet. With the exception of the last mile the trail is good, and with only a little cutting, quite suitable for pack-horses; this trail is in the E. and N. Railway Belt and is kept open as a fire trail by the Canadian Pacific Railway. The last mile to the cabin, although not in a burnt-over area, is covered by numerous windfalls of large timber, and because of the frequency of these falls it would be unwise to attempt to keep this part of the trail open.

The showings are on the steep northerly slopes of Mt. Buttle. For the most part this hillside is heavily wooded with large hemlock, but towards the top and in the vicinity of the showings, steep, rock canyons, in part inaccessible, prevail. The upper parts of Mt. Buttle, between elevations of 4,100 and 4,900 feet are relatively open and the cover alpine.

The deposit consists of single quartz veins that carry small amounts of molybdenite. The veins range in width from 1 inch to 54 inches, and in exposed length, from a few feet to an observed maximum of 37 feet. They occur over an area that measures 6,500 feet in a north-south direction, by 1,800 feet in an east-west direction (Fig. 7). Samples taken by the writer from mineralized quartz veins assayed from: Molybdenite, trace to 0.4 per cent.

The quartz veins cut granitic rocks that range from quartz-diorite through granodiorite to granite in composition. Showings Nos. 1 to 16, inclusive, are in quartz-diorite; Nos. 17 and 18 in granodiorite, and Nos. 22 and 23 in granite; Nos. 19 to 21 are in pyritized greenstone.

Quartz-diorite is the most abundant rock type, and extends southerly from the cabin for approximately 3,500 feet, and easterly for a minimum distance of 1,000 feet. Outcrops were seen on the trail for approximately one mile northerly from the camp-cabin; traverses were not made to the east. The quartz-diorite, as exposed on the Allies, probably represents the south-westerly part of a large mass that extends north-easterly.

A section of granodiorite, approximately 500 feet wide, was observed in a canyon at a point towards the southern margin of the area of quartz-diorite; the actual contact with the quartz-diorite was not seen.

Andesitic greenstone occurs on the east and west peaks of Buttle Mountain, and extends northerly down to a bench 500 feet below; this bench is 800 feet above and 2,500 feet southerly from the camp-cabin.

Granite dykes cut the greenstone in many places, and extend from the bench south-easterly over the pass between the east and west peaks of Buttle Mountain. These dykes strike north-westerly and range in width from 25 feet to 750 feet.

The following paragraphs form a detailed description of the showings, their position is given on Fig. 7.

No. 1 is a cut that has been driven south 23 degrees east for 17 feet. This cut exposes a quartz vein that strikes south 23 degrees east, dips 80 degrees north-eastward and ranges from 18 to 20 inches in width. The vein is mostly milky quartz and contains only a small amount of sulphides. The sulphides include patches of pyrite, a little chalcopyrite and a little molybdenite; the molybdenite occurs as rosettes from 1/4 to 1/2 an inch in diameter.

The continuation of this vein is seen 20 feet north-westerly in the bed of the creek, where it is 2 feet wide and exposed for 14 feet. Only one small patch of molybdenite was seen, 5 inches long, and 3/4 of an inch at its widest part.

No. 2 is a water-hole 5 feet square by one foot deep; dirt in the bottom obscured the vein reported to be there. Material on the dump consists of quartz containing pyrite and small amounts of molybdenite intimately associated with the pyrite.

No. 3 is a trench 12 feet long that exposes an 18-inch wide quartz vein for 3 feet. The quartz contains pyrite and a few molybdenite rosettes.

No. 4 is an irregularly shaped water-filled pit approximately 5 feet in diameter by 2 feet deep; quartz boulders of mineralization similar to the above are scattered around it.

No. 5 is a water-filled pit that did not reach bed-rock.

No. 6 is a shaft filled with water, and is reported to be approximately 50 feet deep. A vein containing traces of sulphides in the quartz and ranging in width from 15 to 18 inches, extends from the north-west corner of the shaft north-westerly across the rock-floor of the canyon for a distance of 15 feet. A picked sample from the dump assayed: Molybdenite,

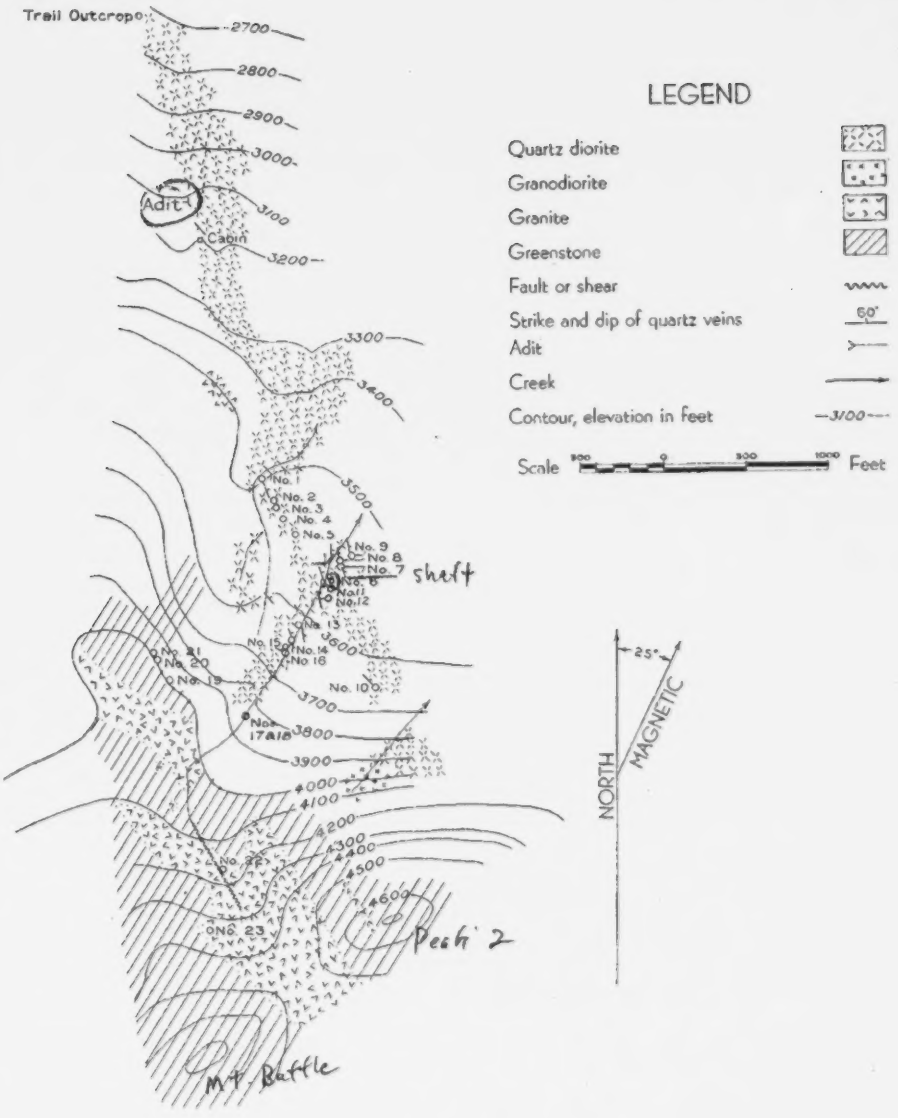


Fig. 7. Allies molybdenite property: pace, compass and barometer survey.

1.5 per cent. Several other veins were seen in the floor of the canyon down-stream and up-stream from the shaft. These veins range from one inch to 10 inches in width and contain traces of molybdenite; the position and strike of these veins, showings Nos. 7 to 16, inclusive, are with the exception of No. 10, shown on Fig. 7.

No. 10 is an open-cut that has been driven for 18 feet at south 39 degrees east to a face 10 feet high. The vein in the face is 4 feet wide and contains patches of pyrite and small amounts of molybdenite. A sample taken across the full width of the vein assayed: Molybdenite, 0.4 per cent.

Nos.17 and 18 consist of narrow, relatively barren quartz veins in a rocky canyon; they range from 2 to 10 inches wide and contain traces of molybdenite.

Nos. 19 to 21 are small open-cuts that expose pyritized greenstone; quartz veins and molybdenite are absent.

Nos. 22 is an open-cut that has been driven north 45 degrees east for 15 feet into the north-east wall of a canyon. It exposes two shears in the face that strike north 30 degrees west and dip from 60 degrees to 75 degrees north-eastward, but converge above the working. The shears contain quartz with much more pyrite than is common in the previously described veins, and small amounts of sheared molybdenite. The vein material is lenticular and ranges in width from a knife-edge to 6 inches; there is no increase in width after the shears converge. In this same canyon there are two other shears that out-crop for only a few feet along their strike and contain small amounts of sulphide.

The adit, 80 feet below the cabin, driven in a direction south 12 degrees east for 28 feet follows a quartz vein 54 inches wide that contains a small amount of pyrite, pyrrhotite and a trace of molybdenite. This vein has been faulted within 5 feet of the face.

No. 23 consists of two parallel veins, one 6 inches and the other 10 inches wide. The quartz contains traces of sulphides.

ANNOTATED BIBLIOGRAPHY.

Bureau of Mines, Dept. of Mines and Resources, Canada. (Mar. 1939). Molybdenite in 1938.

Butler, B. S. and Vanderwilt, J. W. (1933) The Climax Molybdenum Deposit, Colorado, U. S. Geol. Surv. Bull. 846-C.

Dana, E. S. (1922) Text-book of Mineralogy for properties of molybdenum minerals.

Dolmage, V. (1922) Coast and Islands of British Columbia between Douglas Channel and the Alaskan Boundary. Geol. Surv. Canada, Sum. Rept. Part A.

Drysdale, Chas. W. (1915) Notes on the Geology of the "Molly" Molybdenite Mine, Lost Creek, Nelson, M. D., Trans. Can. Inst. Min. Met. Vol. XVIII.

Emmons, W. H. (1935) Origin of Certain Systems of Ore-bearing Fractures, Trans. Am. Inst. Min. and Met., Vol. 115, pp. 9-35.

.. (1938) Diatremes and Certain Ore-bearing Pipes, T. P. 891, Am. Inst. Min. and Met., pp. 1-15.

Hanson, George (1935) Portland Canal Area, British Columbia, Geo. Surv. Canada, Mem. 175.

Hess, F. L. (1923) Ilsemannite at Ouray, Utah, U. S. Geol. Surv. Bull. 750-A.

.. (1924) Molybdenum Deposits, U. S. Geol. Surv., Bull. 761.

Lilley, E. R. (1936) Economic Geology of Mineral Deposits, Henry Holt and Co., New York, pp. 438 - 442.

Lindgren, Waldemar (1933) Mineral Deposits, McGraw-Hill Book Co., New York, pp. 769-771.

McConnell, R. G. (1913) Portion of Portland Canal and Skeena Mining Division, Skeena District, B. C., Geol. Surv., Canada, Mem. 32.

Perry, V. D. (1933) Applied Geology at Cananea, Sonora, Lindgren, Volume, Am. Inst., Min. and Met., pp. 701-709.

Phillips, W. H. (1935) Molybdenite--Modern Uses of Non-ferrous Metals; Am. Inst. Min. and Met. Eng., pp. 217-228.

Rastall, R. H. (1922) Molybdenum Ores, Imperial Institute, London.

Ridgway, R. H. and Davis, H. W. (1939) Minerals Yearbook, Bureau of Mines, pp. 615-620.

Vanderwilt, J. W. (1933) Molybdenite Deposits - Ore Deposits of the Western States; Am. Inst. Min. and Met. Eng., Lindgren Volume pp. 570-573.

.. (1938) Geology of the "Questa" Molybdenite Deposit, Taos, County, New Mexico, Colorado Scientific Society.

Walker, J. F. (1934) Geology and Mineral Deposits of the Salmo Map-Area, British Col., Geol. Surv. Canada, Mem. 172.

Walker, T. L. (1911) Molybdenum Ores of Canada, Mines Branch Pub. No. 93, Dept. of Mines, Canada.

Wilmot, V. L. Eardley - (1925) Molybdenum, Mines Branch, Pub. No. 592, Dept. of Mines, Canada.

APPENDIX.

INDEX OF KNOWN OCCURRENCES OF MOLYBDENITE IN BRITISH COLUMBIA

(Occurrences marked with an asterisk described in this bulletin.)

Ashcroft Area

No. as on Key Map (frontispiece)

1 Martel property*

16 miles south of Ashcroft; narrow quartz veins in sediments; extensive underground workings and open-cuts.

Reference: (7) p. 18.

2 Tamarack group

Near Gnawed Mt., Highland Valley, 20 miles south-east of Ashcroft. Molybdenite associated in small amounts with chalcopyrite in joint planes in granitic rocks. Twenty-foot shaft, pits and stripping. One ton of ore shipped.

References: (2) p. 52; (1) p. 32.

Bella Coola Area

3 Heino, A., prospect of

On mainland near Hunter Island, near Ocean Falls. Flake molybdenite in quartz stringers.

Reference: (3) p. 124.

4 Merkel, prospect of

Near Hagensborg.

Reference: (6).

5 Schonovitch prospect.

Near Namu.

Reference: (6).

Chilko Lake Area

6 Franklin Arm, Chilko Lake.

Occurrence reported by R. P. Bishop of Victoria and possibly that referred to in the reference.

Reference: (5) 1917, p. 132.

Cranbrook Area

7 St. Mary's River, forks of

Molybdenum associated with bismuth.

Reference: (5) 1917, p. 180.

8 Sunnyside-Sunset claims

In St. Mary's pass, 20 miles north-west of Marysville station. Fine-grained molybdenite in quartz veins that occur in quartzite.

Reference: (2) p. 56.

Ft. Fraser Area

9 Stella group*

Near Endako, south-west of Fraser Lake. Ribbon molybdenite in quartz veins. Open-cuts, incline and adit.

Reference: (7) p. 23

Grand Forks Area

10 Franklin Camp

Molybdenite associated with chalcopyrite in shear-zones in granodiorite - no development.

Reference: (1) p. 49.

11 Midas group*

Near Farron, east of Cascade and Grand Forks on the Kettle Valley Railway. Molybdenite disseminated in syenite and in narrow quartz veins. Several short adits and an incline.

Reference: (7) p. 33.

12 Thomson estate, property of*

West of Lafferty, near Cascade. Molybdenite disseminated in quartz-feldspar gneiss. Strippings.

Reference: (7) p. 39

Greenwood Area

13 Carmi mine

Near Carmi station, north of Greenwood. Molybdenite occurs with copper ores, no development for molybdenite.

Reference: (1) p. 49.

14 Younkin prospect near Bridesville.

7 miles from Bridesville on the Camp McKinney road. Flake molybdenite in a 1-foot quartz veins. A small shaft has been sunk on the vein.

Reference: (3) p. 127.

15 Younkin prospect near Camp McKinney

5 miles north-east of Camp McKinney. 18-inch seam of micaceous molybdenite.

Reference: (3) p. 127.

Hazelton Area

16 Black Prince and Wonder

At head of Mud Creek, which flows eastward into Bulkley River about 10 miles above New

Hazelton. Molybdenite and wolframite associated with pyrite, chalcopyrite and galena.

Reference: (5) 1914, p. 205.

17 New Hazelton Gold-Cobalt Mines

On Rocher Déboulé Mt., south of Hazelton. Molybdenite occurs in veins of cobalt sulphides in granodiorite. Extensive adits, shafts and pits. Shipped 27 tons yielding 430 lbs. molybdenite, in 1917 and 1918.

Reference: (5) 1917, p. 103.

18 Thom prospect

On Suskwa River 4 miles from the Hazelton-Manson Creek trail and 27 miles east of Hazelton.

Reference: (6)

Kamloops Area

19 Anticlimax*

17 1/2 miles north-west of Little Fort (Mt. Olie) which is 60 miles north of Kamloops. Quartz lens in granitic rocks. Open-cuts and strippings.

Reference: (7) p. 42.

20 Beresford, South

Prospect at South Beresford near Knutsford.

Reference: (6)

21 Kenallan *

An old prospect 4 miles south of Westwold. Molybdenite disseminated with sulphides in lime-garnet zones in limestone. Numerous strippings, open-cuts and short inclines.

Reference: (7) p. 57.

22 Naismith prospect

Near Red Lake, 30 miles north-west of Kamloops.

Reference: (6)

23 Pearson prospect

Near Stump Lake.

Reference: (6).

24 Sands Creek claims *

On Sands Creek, which flows into the Clearwater River near Clearwater Station. An 18-inch quartz-molybdenite vein in granitic rock. Stripping.

Reference: (7) p. 65.

Lac la Hache Area

25 Boss Mt. *

Property of the Consolidated Mining and Smelting Co. 40 miles north-east of Lac la Hache. Breccia-pipe in quartz-diorite sealed by quartz and molybdenite; also several small quartz-molybdenite veins. 3 short adits, 1 shaft, several open-cuts. 1000 lbs. of ore yielding 350 lbs. molybdenite shipped.

Reference: (7) p. 68.

Lardeau Area

26 Copper Chief

On west side of Trout Creek, near Trout Lake. A small vein following a diorite dyke. Several open-cuts.

Reference: (5) 1917, p. 191.

27 Garvey and Foss claims, Duncan River.

North of Kootenay Lake. Molybdenite in quartz veins that cut mica schist. Numerous open-cuts.

Reference: (1) p. 31.

Lillooet Area

28 Croteau prospect

Approximately 20 miles south of Lillooet, near the Index Molybdenite property.

Reference: (6)

29 Index Mine

On Texas Creek, 15 miles south-west of Lillooet. Fracture-zone in granite mineralized with molybdenite. Several pits, trenches and adits.

References: (1) p. 34; (4) Summ. 1916, p. 54; (5) 1916, p. 272.

Lower Mainland Coast and Coastal Islands Area

30 Bentham prospect *

On Haslam Lake, near Powell River. Molybdenite in quartz stringers in joints in granite. Strippings.

Reference: (7) p. 88

31 Bower, Gideon, prospect of

1 1/2 miles from shore of north arm of Burrard Inlet and opposite Croker Island.

Reference: (2) p. 52.

32 Britannia Mine.

On Howe Sound. Molybdenite sometimes associated with chalcopyrite in shear-zones.

Reference: (1) p. 52.

33 Clowham Lake, prospect near.

Near Sechelt Inlet. Vague reports of showings.

Reference: (3) p. 125.

34 Cortez Island.

Occurrence east of Carrington Bay on Cortez Island. Small quantities of molybdenite in quartz veins in granite.

Reference: (4) 1886, p. 23-B.

35 Cypress Creek, claims near.

On Burrard Inlet. Reported high return in molybdenum.

Reference: (5) p. K-301.

36 Gem property

Near Gordon Pasha Lake, near Powell River.

Reference: (6).

37 Grayson-Otto prospect.

On Knight Inlet. Flake molybdenite in narrow quartz veins.

Reference: (3) p. 125.

38 Jervis Inlet. *

Prospect above Jervis Inlet and opposite Princess Louisa Arm. Scattered rosettes and patches of molybdenite in granite.

Reference: (7) p. 93

39 Lucky Swede

Prospect owned by Perry Hanson on Sonoro Island.

Reference: (6).

40 Lynn Creek

Molybdenite associated with sulphides and calcite. Several adits.

Reference: (1) p. 52.

41 Ottawa Central

Quadra Island, one-half mile west of Bald Point. A little molybdenite in limestone.

Reference: (5) 1922, p. 241.

42 Pleasant Lake, prospect near.

5 1/2 miles south of Jervis Inlet. Flake molybdenite in quartz and granite.

Reference: (3) p. 125.

43 Powell Lake.

Prospect on shores. Fine-grained molybdenite in quartz.

Reference: (1) p. 50.

44 Soule claims

Near head of the North Arm Burrard Inlet, 2 miles up the valley of a small stream. Molybdenite in a 14-inch quartz vein in granite.

Reference: (2) p. 52.

45 Texada Island.

Associated with chalcopyrite in many of the old copper mines.

Reference: (2) p. 50.

Merritt Area

46 Copper King Mine.

Near Mamette Lake, north of Merritt. Associated with an excess of chalcopyrite in al-

tered granite.

References: (1) p. 50; (5) p. 233.

Nakusp Area

47 Bourne prospect.

Near Nakusp, on Upper Arrow Lake. Molybdenite in quartz veins. Numerous open-cuts.

Reference: (1) p. 49.

Nelson Area

48 Free Silver

On Quartz Creek, west of Ymir. Molybdenite with sulphides in vein in monzonite.

Reference: (1) p. 50.

49 Gray Creek prospect*

East side of Kootenay Lake. 3-foot quartz vein in granite. Adit, 175 feet long, along the vein.

Reference: (7) p. 49.

50 Little Keen*

On Sheep Creek, south of Salmo, owned by J. Sapples. Molybdenite in a lime-silicate zone. Several open-cuts and strippings.

Reference: (7) p. 97.

51 Lucky Boy

South side of Sheep Creek, near Salmo. A small amount of molybdenite associated with pyrite, sphalerite and galena.

Reference: (5) 1926, p. 278.

52 Molly mine *

On Lost Creek, south of Salmo. Molybdenite disseminated and in seams in granite and pegmatite. 202 tons shipped, 10 tons MoS_2 recovered.

References: (1) p. 36; (7) p. 102

53 Pegleg

Near head of south fork of Fry Creek, east side of Kootenay Lake.

Reference: (5) 1926, p. 260.

54 Tier prospect

Near Roseberry, 3 miles up Wilson Creek. Faulted quartz vein, 4 feet wide, showing rosettes and flakes of molybdenite.

References: (3) p. 128 and (6)

New Westminster Area

55 Dupres-Knight, prospect

On south side of Fraser River, near Cheam View. Molybdenite occurring in lenses of quartz in granite.

Reference: (3) p. 126.

56 Empress group

4 miles north of Agassiz. Molybdenite is associated with magnetite and sulphides in lime-silicate zone. Extensive workings for copper, no molybdenite saved.

Reference: (5) 1917, p. 286.

57 Hicks discovery

Occurrence on Hurling Mt., and 7 miles east of Agassiz Station.

Reference: (5) 1917, p. 285.

58 Lindeman prospect.

On mountain west of north end Chilliwack Lake.

Reference: (3) p. 126.

59 H. L. M. group

On Silver Creek, east side of Harrison Lake. Molybdenite occurs in narrow quartz veins in granitic rocks.

Reference: (6).

60 Jamieson prospect

On north fork of Spuzzum Creek. Molybdenite reported to occur with free gold.

Reference: (1) p. 48.

61 Last Chance group

On south side of Hurling's Mt., 7 miles east of Agassiz. Molybdenite occurs with other sulphides in metamorphosed limestone.

Reference: (5) 1917, p. K-289.

62 Margaret property *

B. C. Molybdenite Co. property on Boise (Canon) Creek, north of Pitt Lake. Molybdenite occurs in one short, 2-foot shear-zone and in several narrow quartz veins, all in quartz-diorite. Workings consist of 1 short adit and several open-cuts and strippings.

Reference: (7) p. 109.

63 Dominion property

West of Iago on the Coquihalla River.

Reference: (6).

64 Old Rainbow claim

On Twenty-two Mile Creek, on the Skagit River, south of Hope.

Reference: (1) p. 48.

65 Stave River group

Near Upper Stave River, about 6 miles northwest of the head of Stave Lake. Molybdenite occurs in silicified shears in granitic rock.

Reference: (5) 1917, p. K-288.

66 St. Paul group

On west side of Pitt Lake. A 4-foot molybdenite vein that had been uncovered for 400 feet.

Reference: (5) 1901, p. 1121.

Penticton Area

67 Golconda mine

One mile west and 1,100 feet above town of Olalla. Fine-grained molybdenite and chalcopyrite disseminated in pyroxenite; 4390 lbs. of 17.11% molybdenite shipped to Ottawa in 1917. Workings consist of adits, shaft, and strippings.

Reference: (1) p. 43.

68 West Summerland, prospect near.

Molybdenite in quartz vein at contact of granite and schist. Stripping and trenching, 246 lbs. of 0.3% material shipped.

Reference: (1) p. 51.

Portland Canal Area

69 Caribou group

On Lime Creek on south shore of Alice Arm. Molybdenite occurs in a stockwork of interlacing quartz stringers in granite.

References: (3) p. 124; (5) 1930, p. 86.

70 Fitzgerald prospect

On Strohn Creek, near Meziadin Lake. Molybdenite in a quartz vein that ranges from 3 to 6 feet wide, in granite.

References: (5) 1917, p. F-68; (6)

71 Haahti, John, prospect of

Near Stewart.

Reference: (6).

72 Mammoth Mine

On Observatory Inlet. Fine-grained molybdenite in quartz veins.

Reference: (1) p. 51

73 Molly B

East side of Bear River, one-half mile from tidewater and across the river from town of Stewart. Molybdenite with other sulphides associated with a 10-foot zone of lime silicates in altered greenstone.

Reference: (5) 1918, p. K-76.

74 Tidewater Molybdenum group*

On north side of Alice Arm, 4 miles from its head. Molybdenite occurs in numerous quartz lenses in sediments and andesitic greenstones. Extensive underground workings, 383 tons of ore shipped.

Reference: (7) p. 116.

Princeton Area

75 Ashnola Creek

Prospect 5 miles up the creek. Flake molybdenite in quartz.

Reference: (3) p. 127.

76 Galarneau prospect

On Champion Creek, south-west of Tulameen. Low-grade ore in a zone 8 to 12 feet wide.

Reference: (3) p. 127.

77 Granite Creek, occurrence on

One-half mile up Granite Creek, 6 miles east of Tulameen.

Reference: (3) p. 127.

78 Independence camp

On Coldwater River. Molybdenite with chalcopyrite in granite porphyry. Noticed in mining for copper.

Reference: (1) p. 51.

79 Twenty-one Mile Creek, prospect near

Near Hedley. Molybdenite sparingly distributed through granitic rocks.

Reference: (1) p. 51.

Revelstoke Area

80 L. H. group *

Near Malakwa, south-west of Revelstoke. Molybdenite in shear-zone in granite. 1 short adit and strippings.

Reference: (7) p. 132.

81 Sterling group*

35 miles north of Revelstoke, on Big Bend highway. Molybdenite in silicified zone in schist. Several short adits.

Reference: (7) p. 138.

Rossland Area

82 Giant mine

At Rossland. Fine-grained molybdenite associated with chalcopyrite along fracture planes in granite.

Reference: (1) p. 52.

83 Rossland camp

Molybdenite seen in several of the gold-copper mines.

References: (1) p. 46; (2) p. 54.

Terrace Area

84 Bradle Bane group

One mile east of Skeena River and 5 miles north-east of Usk. Veinlets of pyrite with a little galena and molybdenite in tuff.

Reference: (4) Mem. 212, p. 36.

85 B. X.

On Kleanza Creek, 6 miles from its mouth, and 8 miles from Usk. Molybdenite occurs in a 4-foot quartz vein in greenstone.

Reference: (5) 1928, p. C-146.

86 Emma and North Star claims

Near head of Kitamaat Arm.

Reference: (4) 1899, p. 656.

87 Eureka claim

On Thornhill Mt. east of Lakelse Lake. Owned by J. A. Michaud. Rosettes of molybdenite associated with small pegmatite dykes in granite.

Reference: (4) Mem. 205, p. 33.

88 Kitsumgallum Lake.

Occurrence 5 miles north of the lake. Molybdenite occurs in reddish quartz.

Reference: (3) p. 125.

89 Molybdenum group

Near Zimacord River. Molybdenite in quartz veinlets in diorite dykes.

Reference: (1) p. 51.

90 Nicholson Creek Mining Corporation

Between Lowrie and Nicholson Creeks, near Usk. Molybdenite in small quantities in quartz-pyrite veins in fractured grano-diorite. Extensive underground workings.

References: (5) 1928, p. 145; 1935, pp. C-7-C-10.

Vancouver Island Area

91 Allies group*

On Buttle mountain, 30 miles south-east of Nanaimo. Flake and rosette molybdenite in granitic rocks. Several open-cuts, 2 short adits and 1 shaft.

Reference: (7) p. 146.

92 Comego group

On Cottonwood Creek, north of Cowichan Lake.

Reference: (6).

93 Fanny Bay

On north passage in Fanny Bay, east side of Vancouver Island. Molybdenite in narrow quartz veins in granite.

References: (1) p. 50; (4) Mem. 23, p. 141.

94 Goodspeed, prospect of

Near Port Hardy.

Reference: (6).

95 Sharpe, prospect of

Near Tofino, west coast Vancouver Island.

Reference: (6).

Vernon Area

96 Armstrong camp

Aberdeen Mt.. near Vernon.
Associated with galena in quartz vein; no development for molybdenite.

Reference: (1) p. 52.

97 Bertram, prospect of

Near Vernon.

Reference: (6).

98 Eagle prospect

Near Beaulieu Lake, 30 miles south of Westwold.

Reference: (6).

Key to References in Appendix

1. Wilmot, V. L. Eardley - (1925) Molybdenum, Mines Branch, Pub. No. 592, Dept. of Mines, Canada.

2. Walker, T. L. (1911) Molybdenum Ores of Canada, Mines Branch, Pub. No. 93, Dept. of Mines, Canada.

3. Munitions Resources Commission, Canada (1920).

4. Geological Survey of Canada, (Mem. - Memoir; Summ. - Summary Report).

5. Annual Reports Minister of Mines, British Columbia.

6. Private information, Dept. of Mines, Victoria.

7. See description in text of this report.